DETECTION OF DISEASES IN THE ORAL CAVITY, DETECTION OF DENTAL CARIES USING CNN

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Annotation. Dental health is an important part of our overall health. Advances in artificial intelligence and machine learning have contributed greatly to us, and one of them is image classification. Using image classification algorithms, we can now easily classify images of objects or objects into groups based on differences in color, structure, or texture. The same can be used to detect oral diseases in humans based on images of the mouth or teeth. The features of the images are used to classify them by comparing them with a dataset of images. A convolutional neural network (CNN) system was adopted.In this article, we conducted a small experiment on the diagnosis of dental images.

Key words. Medical imaging, importan, technology, Diagnosing of diseases, Convolutional Neural Network (CNN)

Introduction. Personality Advancement in science and technology has changed our lives in the current world. The way things used to work decades ago has changed exponentially in recent times. Medical imaging technologies have also coped up and are developing at a very rapid rate in recent times. The advancement in science and technology has helped in obtaining reliable results in the medical imaging techniques [1]. Even the innermost teeth can be visualized clearly with the help of cameras to enhance dental imaging [2]. As new equipment's are being developed each day, they help in diagnosing oral issues at a very early stage. Diagnosing of diseases at an early stage is important as it may prevent the patients from suffering from many inherent diseases that come associated with these. Sometimes certain diseases may look very simple at first; but if not taken care of at an early stage may lead to other diseases that are much more severe and even life threatening.

Convolutional Neural Network (CNN) has been implemented in the proposed model for identification of teeth abnormalities. CNN is a special kind of multi-layer neural network which requires little to no image preprocessing and can directly recognize patterns from pixel images. It consists of two elements- Convolutional

layers and Pooling layers. These layers have infinite possibilities of arrangements and in each layer features of the image are automatically extracted (which is also why CNN is becoming so popular) and as the convoluted features are passed on through the different layers; it generates more invariance and abstract features eventually resulting it to get the final output which is invariant to occlusions.

Confusion Matrix of the Model

Accuracy - It shows the overall accuracy of the model i.e., the fraction of the total samples that were correctly classified by the classifier. To calculate accuracy, following formula is used

$$\textbf{Accuracy}=(TP+TN)/(TP+TN+FP+FN) \quad (1)$$

Precision - It shows that what fraction of predictions as a positive class were actually positive. To calculate precision following formula is used.

$$\textbf{Precision}=TP/(TP+FP) \quad (2)$$

Recall/Sensitivity - It shows that what fraction of all positive samples was correctly predicted as positive by the classifier. To calculate recall/sensitivity the following formula is used.

$$\textbf{Recall/Sensitivity}=TP/(TP+FN) \quad (3)$$

F1-score - It combines precision and recall into a single measure or a value. To calculate F1-score the following formula is used.

$$F1-Score=2*((Precision*Recall)/(Precision\ Recall))$$

$$F1-Score=2TP/(2TP+FP+FN) \quad (4)$$

Macro Avg - It calculates metrics for each class individually and then takes unweighted mean of the measures. It uses the following formula.

$$\textbf{Macro Avg}=(\textbf{Class [0] f1-score}+\textbf{Class [1] f1-score}+\textbf{Class [2] f1-score})/3 \quad (5)$$

Weighted Avg - It takes a weighted mean of the measures. It uses the following formula.

Weighted Avg = ((Class [0] f1−score∗Number of images of Class [0] + Class [1] f1−score∗Number of images of Class [1] + Class [2] f1−socre∗Number of images of Class [2]/Number of Class [0]+Number of images of Class [1] Number of images ofClass [2])

In the proposed model [0] corresponds to caries images, [1] corresponds to cancer images and [2] corresponds to normal tooth images.

Table 1 shows the number of True positives **(TN),** False Positives **(FP),** False Negatives **(FN),** and True Negatives **(TN).**

Table 1: Confusion matrix results

Classes	True positives (TP)	True Negatives (TN)	False Positives (FP)	False Negatives (FN)
Caries [0]	36	152	3	7
Cancer [1]	93	99	3	3
Normal Tooth [2]	59	135	4	0

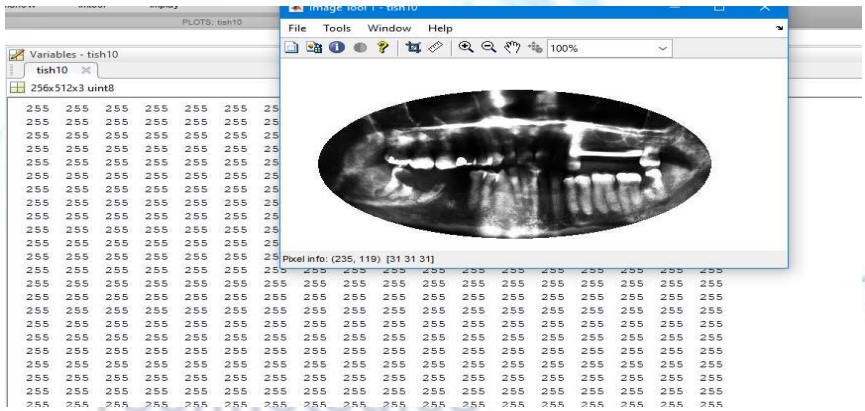

Fig 1: Cancer image output

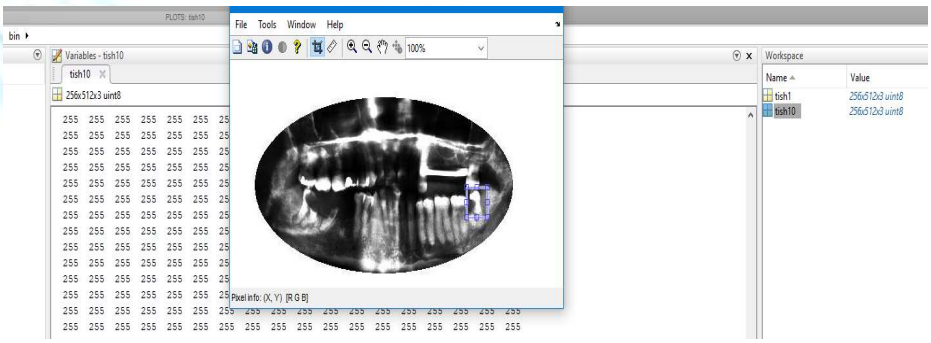

Fig 2: Determining the disease in the image

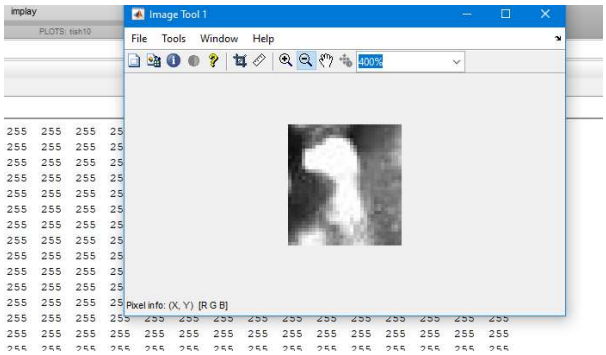

Fig 3: Caries image output

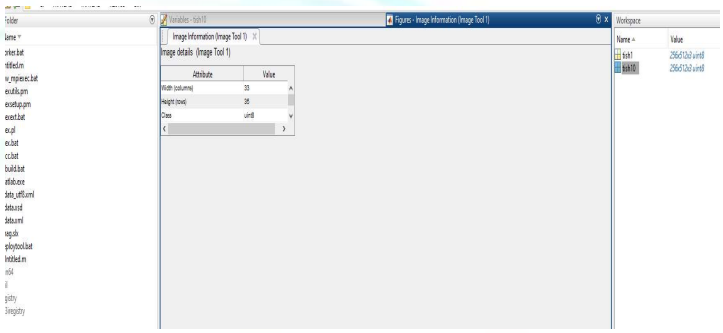

Fig 4. describe the image

Conclusion. Digital Imaging and Image Classification algorithms/models are being developed now which can help doctors diagnose defects or diseases much more efficiently and accurately. Machine Learning algorithms are not able to do it themselves so it is done by training the models with huge amounts of data to classify and recognize the patterns in images much more accurately. These models can be used in Hospitals, Medical Centers and sometimes patients can even diagnose the diseases just by uploading a picture of the affected part to the model. The results in the paper demonstrate that through the use of advanced image processing, classification techniques can help in easily diagnosing dental caries and oral cancer and at the same time also identify healthy teeth. Through the metrics and graphical representation, the data can be leveraged in understanding more about the problems and improve the model itself. Also, the real time results give an upper hand in proceeding with the diagnosis and treatment of the diseases. However, the reliability and accuracy of the results can be further enhanced through the use of a larger database.

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