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Bone Tumor Detection from Oestosarcoma Histology Images using Machine Learning

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Abstract - *Bone cancer is one of the life threatening diseases which may cause death to many individuals. There must be an accurate detection and classification system available to diagnose bone cancer at early stage. Early detection of cancer seems to be the important factor in increasing the chance of cancer patient survival. Bone cancer is one of the types of cancer. It is a malicious and malignant disease, caused due to uncontrolled division of cells in the bone. The most threatening and customarily occurred cancer is bone cancer. For tumor detection various techniques such as MRI(Magnetic Resonance Imaging), CT(Computerised tomography) In this paper an approach of tumor detection and classification have been proposed using machine learning in Tensorflow platform and the data set used for this purpose is osteosarcoma histology images.*

Key Words: malicious, malignant, machine learning, tensorflow, cancer

1. INTRODUCTION

Cancer is the most sacrificed disease all over the globe. Which is clinically referred as a malevolent neoplasm, it is a multifarious genetic disease that is caused primarily by the environmental factors. As the proper treatment is not available most of the patient get died but the number of deaths can be reduced by means of early detection of cancer so as to proceed for controlling methods. Unfettered cell growth is the symptom of cancer leading to form the malevolent tumors, which assaults the nearby body tissues. These tumors further grows and impede the circulatory system, nervous and digestive system and also can liberate hormones that leads to amend the proper body function. Early detection of cancer seems to be the important factor in increasing the chance of cancer patient survival.

Bone disease begins in the bone. Malignancy begins when cells in the body start to become wild. Cells in almost any piece of the body can progress toward becoming tumor, and can spread to different zones of the body Bone cancer is one of the life threatening diseases which may cause death to many individuals. It caused due to uncontrolled division of cells in the bone. Earlier detection and classification of cancer is most challenging problem.

Clinically the bone cancer is termed as the Sarcomas, which initiates in the muscle, bone, fibrous tissue, blood vessels, some tissues. Some of the most common types of bone cancer are osteosarcoma, chondrosarcoma, ewings sarcoma, pleomorphic sarcoma, fibrosarcoma. In bone cancer the tumor gets formed into the bone and affect the bone growth, bone movement. Specifically in the bone tumor consideration, Enchondroma is a type of benign tumor found inside the bone which begins at the cartilage. In most of the cases Enchondroma found in the small bones of hand, possible susceptible bone areas for Enchondroma are the femur (thigh bone), tibia (shin bone), humerus (upper arm bone).

2. METHODOLOGY

In this paper a method is introduced to detect bone cancer and classify it into different classes i,e Non-tumor, Viable, Non-viable, Non-Viable-Tumor using machine learning Techniques in Tensorflow Platform. TensorFlow is a machine learning software developed by Google. The unique feature of TensorFlow is that all the data objects are stored as tensors, including scalar values which are considered to be tensors of rank zero. In image processing, grayscale images are stored as rank two tensors (referred as arrays) and colour images are stored as rank three tensors. This makes the implementation of convolutional neural network simple. The entire flow of computations in any TensorFlow program is stored as a computational graph which runs within a session object. For complex machine learning programs, the modules can also be distributed across two or more CPUs and GPUs. The dataset we used in this project are osteosarcoma histology images which is a most common type of cancer that arises in bones. Data set contains 1252 images collected by a team of clinical scientists at University of Texas Southwestern Medical Center, Dallas. Platform used for the project is TensorFlow framework with python3 libraries. The architecture used for image feature extraction is Inception V3. Inception-v3 is a convolutional neural network that is 48 layers deep. We can load a pretrained version of the network trained on more than a million images from the ImageNet database. Image classification analyses the numerical properties of various image features and organizes data into categories. Classification algorithms

typically employ two phases of processing: training and testing. In the initial training phase, characteristic properties of typical image features are isolated and, based on these, a unique description of each classification category, i.e. training class, is created. In the subsequent testing phase, these feature-space partitions are used to classify image features. The fundamental task of image classification is to make sure all the images are categorized according to its specific sectors or groups. Classification is easy for humans but it has proved to be major problems for machines. It consists of unidentified patterns compared to detecting an object as it should be classified to the proper categories. The various applications such as vehicle navigation, robot navigation and remote sensing by using image classification technology. It is still undergoing challenging work and limited resources are needed to improve it. Image classification has become a major challenge in machine vision and has a long history with it. The challenge includes a broad intra-class range of images caused by color, size, environmental conditions and shape. It is required big data of labelled training images and to prepare this big data, it consumes a lot of time and cost as for the training purpose only.

2.1 Dataset used

For the project, the dataset is composed of Hematoxylin and eosin (H&E) stained osteosarcoma histology images. The data was collected by a team of clinical scientists at University of Texas Southwestern Medical Center, Dallas.Contens of this datset:

- → Number of categories: 4
- → Number of images: 1252
- → Total Size (in Mb): 4472 kb

2.2 Image retraining

Modern image recognition models have millions of parameters. Training them from scratch requires a lot of labelled training data and a lot of computing power (hundreds of GPU-hours or more). Transfer learning is a technique that shortcuts much of this by taking a piece of a model that has already been trained on a related task and reusing it in a new model. We can reuse the feature extraction capabilities from powerful image classifiers trained on ImageNet and simply train a new classification layer on top. Though it's not as good as training the full model, this is surprisingly effective for many applications, works with moderate amounts of training data (thousands, not millions of labelled images), and can be run in as little as thirty minutes on a laptop without a GPU. This project uses Archtecture Inception v3 for creating model.

2.3 Image classification with tensorflow.

Before classifying the images it is essential to have a dataset of images to teach the network about the new classes you want to recognize. The dataset here used is the osteosarcoma histology images. It is downloaded and placed in the folder bonedata in google drive. The data sets are classified into four classes and it is imported. Here the bonedata folder is used to specify the image dataset. The Inception architecture is downloaded during the execution of the retraining script. After download for each and every image the feature vectors extracted from the images are created. The features vectors are in the format of a collection of a group of floating points. Then the retraining script trains and creates a model and that model is saved in/content/drive/My Drive/bone_data_model .Then after the model is tested and validated with the dataset divided in a ratio of 3:2 (normally 60% test set and rest 40% validation set) by the retraining script.During training two graphs are there which shows accuracy and validation loss. After that an array is created for storing different classes of the tumors it contains viable, non-viable, non-tumor, non-viable-tumor. After all the training steps .it shows the predicted class of the tumor along with a bar graph in which each bar's height represent the percentage predicted for each class for that particular image.

2.4 Accuracy over retraining time

The following figures represents the Validation Loss and Accuracy calculated during each training steps over retraining phase. The graphs are plotted using Matpotlib.

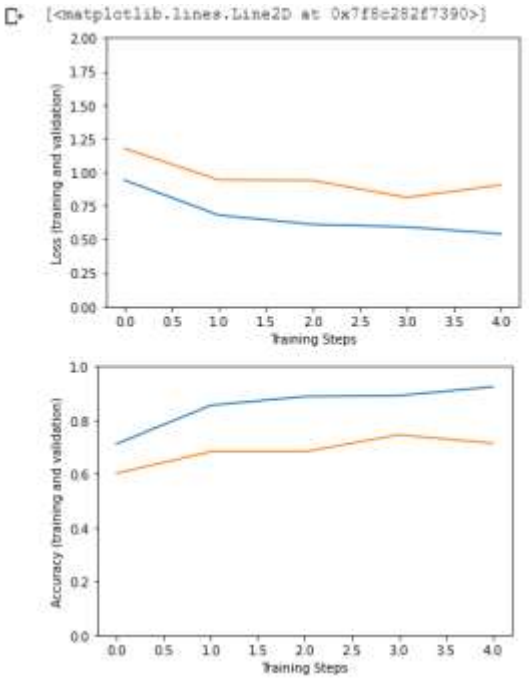

Fig-1: Graph showing accuracy and validation loss.

3. RESULTS

The results obtained during the image classification process are provided in this section. The final results comes up with the classification of tumors into four categories i,e Viable, Non-Tumor, Non-viable-tumor, Non-viable along with a bargraph in which each bar's height represent the percentage predicted for each class for that particular image.

3.1. FINAL CLASSIFICATION

The final result shows the images of cells in which some of them are predicted as Non-viable-Tumor, Non-tumor. The value written in the bracket is the Actual value and the value written on the left side is the Predicted value. The bargraph shows the percentage predicted for each class for that particular image. In the graph '0' represent Non-Tumor,'1' represent Non-viable-Tumor,'2' represent Non-Viable and '3' represent Viable. The Blue colour is the actual class and red is the wrong prediction.

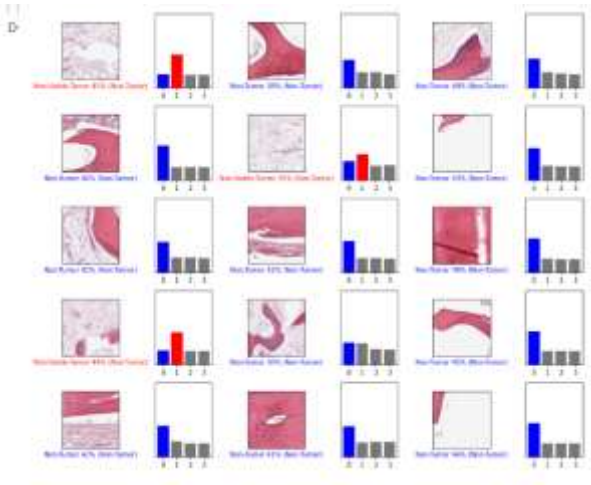

Figure 5.1: classification of tumors into different classes.

4. DISCUSSIONS

The objective of this project was to predict and classify tumors into different categories i,e Non-Tumor, Non-Viable-Tumor, Viable and Non-Viable. The expected result of this project is to get an accurate prediction of tumor into a specific class.

Given a sample of fifteen images as input out of it only three got wrong prediction rest of them are predicted into the Actual class. In the output a bargraph is associated with each image which indicate the percentage predicted for each class for that particular image. The highest percentage for the wrong prediction is 45% and lowest percentage for the wrong prediction is 35%. The highest percentage for the correct prediction is 46% and lowest percentage for the correct prediction is 30%.

5. CONCLUSION

Bone cancer is considered as a multifarious disorder which occurs due to diverse genetic and physiological factors. It produces the uncontrolled growth of the cell making demonic bone tumors and invade to the adjacent parts of the body. Different types of bone tumors are detected in the human bodyBone cancer is a class of diseases that are characterized by an unfettered growth of the cell and it is considered to be the main reasons of early death around the globe. Therefore, early detection and classification of the bone tumor are become needed to cure the patient. This study used machine learning techniques with Tensorflow platform for predicting the tumor. It uses Inception algorithm which actually uses the techniques of Convolutional neural network (CNN) to create image classification model. This project classified bone tumors into

four classes. Out of fifteen samples given 12 got correct prediction and three got wrong prediction. The study revealed that the images with low colour have a chance to gives a wrong prediction.

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