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Develop Model for Detection and Localization of Brain Tumor

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Abstract: ***A brain tumor is growth of damaged cells in your brain. There are many different types of brain tumors. Some brain tumors are non-cancerous (benign) and some brain tumors are cancerous (malignant). Brain tumors can start in your brain (primary brain tumors), or cancer can start in other parts of your body and spread to your brain as secondary (metastatic) brain tumors. The rate at which a brain tumor grows can vary widely. Brain tumor growth rate and location determine how your nervous system functions.***
One of the most important and useful tests performed on the brain is an MRI, which is magnetic resonance imaging. All images are tested and analyzed by a radiologist, due to the rapid development in neural networks and machine learning techniques of high performance systems for detecting the diseased part of a person. Machine learning and neural network models play an important role in computer vision. In this revive paper, we did an analysis on many object detection model and summarize the research done on this domain.
Keywords: Brain tumor detection, YoloV3, darknet-53 framework, machine learning

I. INTRODUCTION

Brain tumor and its analysis are of particular interest because of the developing innovations in medical image processing. Early detection of brain tumor is important to increase the survival rate of people, to prevent disease and reduce disability. There are many methods that are used to detect this disease.
One of the most widely used appropriate tests among them in brain tumor diagnosis is MRI. An MRI technique called "diffusion-weighted imaging" helps show the cellular structure of the brain. Another technique called "perfusion imaging" shows how much blood is getting to the tumor. However, there are other parts of brain which have an identical behavior as these cells can lead to a false diagnosis. There are thousands of patients suffering from brain tumor each year, so the use of deep learning technique for autonomous tumor detection. The WHO classification of brain tumor has come a long way since 1979, but in 2016 classification was quite revolutionary. For the first time, molecular diagnostics were taken into consideration leading to more detailed diagnoses. However, this diagnosis are quite subjective. Some of the common problems in manual detection of tumor are time requirement and misclassification due to complexity of structure. This is where AI entered neuro-oncology a few years ago. Chinese group developed an AI algorithm that classifies the subtype of brain tumor much faster and with better accuracy. classification. In this paper we will discuss about some of the latest research done in this domain. In this paper we will also discuss about YoloV3 – state of the art.

II. LITERATURE SURVEY

A. Brain Tumor Types Classification using K-means Clustering and ANN Approach.

In this research author used K-means Clustering and ANN approach for detection of brain and tumor and brain segmentation. The dataset used was from the "Figshare" website. K-means Clustering was used for segmentation purpose, 2D-DWT was used as feature extractor and artificial neural network with Levenberg-Marquardt training function and 20 neurons was used for classification. Using this technique tumor was classified into three categories: Glioma, Meningioma and Pituitary. The Proposed technique provided 95.4% accuracy.

B. Machine Learning and Deep Learning Approaches for Brain Disease Diagnosis: Principles and Recent Advances.

In this paper author have presented various brain disease detection techniques using machine learning and deep learning. This survey revels some of the important insight into various ML and DL techniques in medical field. This paper concludes about quality of training data and interoperability are also major concerns to develop ML and DL based models for practical uses. This paper also states about lack of medical data in this domain. Problem on lack of data can be solved with some better DL techniques.

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C. Brain Tumor Detection and Classification Using Intelligence Techniques: An Overview.

In this paper author have presented challenges in ML and DL approaches. There is Noise into an MRI scans during image capture process, and removing the noise cannot be dealt easily. To achieve better results, one of the most important task is to extract the optimal features as well as determine the amount of training, validating and testing samples. For faster and more accurate real time detection, the better technique should be proposed.

The better object detection technique should be proposed with speed and accuracy which could be used in real time detection. There are many DL techniques to be used, recently the Yolo model with darknet as its backbone has been performing great.

D. YOLOv3: An Incremental Improvement.

In this paper author have presented that YoloV3 is a good object detector. The speed and accuracy are better than its predecessor. While MRI image is a grayscale image it is lot easier to work with YOLO. YOLOV3 didn't loose any data while upscaling or downscaling as it didn't use pooling layer. YOLO V3 performs better than RestinaNet-50 and is faster as well.

III. BRAIN TUMOR DETECTION

The brain is the most complex organ in human body. The brain controls what you fell and think. Brain also controls things you re less aware off. Brain serves as center of nervous system. About 98% neural tissue are fount in brain and spinal cord. An average brain contains about one hundred billion neurons. A brain tumor is abnormal growth of damaged cells in your brain tissue, which can disrupt the normal functioning of the human body. MRI scans are used to detect brain tumor. Using DL and ML following steps are involved in tumor detection:

A. Pre-Processing

Preprocessing is done to improve the quality of data to feed to the model. This process helps in data cleaning and remove noise from data if any. Preprocessing helps in resizing the image to base scale before feeding it to neural network. Preprocessing helps to speed up training speed and increase classification accuracy of the model.

The Images are converted into arrays using Open-cv module. The labels on the other had should be available in the format of center, width and length or in the format x-min, y-min, x-max, y-max. If the label available to us in the form of coordinates the it must be converted into center, width and length.

B. Splitting Dataset

The dataset is split into three parts, training set, validation set and testing set. The training and validation set are used for model building and validation set is used to confirm the accuracy of the model.

C. Classification and Detection

This step aims to classify abnormal tissue from the normal tissue to classify the tumor. There are segmentation techniques which are manual, semi-automatic and fully automatic. Manual techniques are time consuming because tumor has to be classified manually. Best approach is to propose a fully automatic object detection technique. In automatic detection values of the parameter do not have to be set manually which will save a lot of time.

IV. PROPOSED SYSTEM

Brain tumor detection using machine learning and deep learning has been developed using various algorithms. We have implemented the system using the following process as given below. The implementation of yolo is done by using the darknet framework.

The darknet framework requires some necessary file, those files are data file, configuration file, weights. The data file is simply the file that consist of the class that we are predicting on, the training and testing file which contains the location of the training and test images respectively.

The back-up file where the weights are going to be saved while training. The configuration file contains the convolution architecture and size of the batches on which the data is been trained on.

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	Type	Filters	Size	Output
	Convolutional	32	3 × 3	256 × 256
	Convolutional	64	3 × 3 / 2	128 × 128
1×	Convolutional	32	1 × 1	
	Convolutional	64	3 × 3	
	Residual			128 × 128
	Convolutional	128	3 × 3 / 2	64 × 64
2×	Convolutional	64	1 × 1	
	Convolutional	128	3 × 3	
	Residual			64 × 64
	Convolutional	256	3 × 3 / 2	32 × 32
8×	Convolutional	128	1 × 1	
	Convolutional	256	3 × 3	
	Residual			32 × 32
	Convolutional	512	3 × 3 / 2	16 × 16
8×	Convolutional	256	1 × 1	
	Convolutional	512	3 × 3	
	Residual			16 × 16
	Convolutional	1024	3 × 3 / 2	8 × 8
4×	Convolutional	512	1 × 1	
	Convolutional	1024	3 × 3	
	Residual			8 × 8
	Avgpool		Global	
	Connected		1000	
	Softmax			

Table 1. **Darknet-53.**

Yolo V3 uses Darknet-53 as its backbone. There are 53 layers in yolo to train the model. Darknet is better than ResNet-50 and ResNet-101. There are no fully connected layers and are only convolutional layers which helps to deal with loss of data while downscaling. Yolo V3 follows the grid cell approach. Yolo V3 uses 3 anchor boxes. Each grid cell predicts the bounding box coordinates, the class confidence score and objectness score. Darknet helps with small object detection. The model predicts the probability of each class and the class with the highest probability is been selected and the model also predicts the location of the tumor on that image. The yolo algorithm works in such a way that the Image is divided into grids and the model can predict multiple tumors in the brain the or can predict a single tumor two times, in such case the model selects the best using the non max suppression. In Non-Max Suppression the model with the highest probability is been selected. In such a way the model predicts the Image class and the location of the tumor.

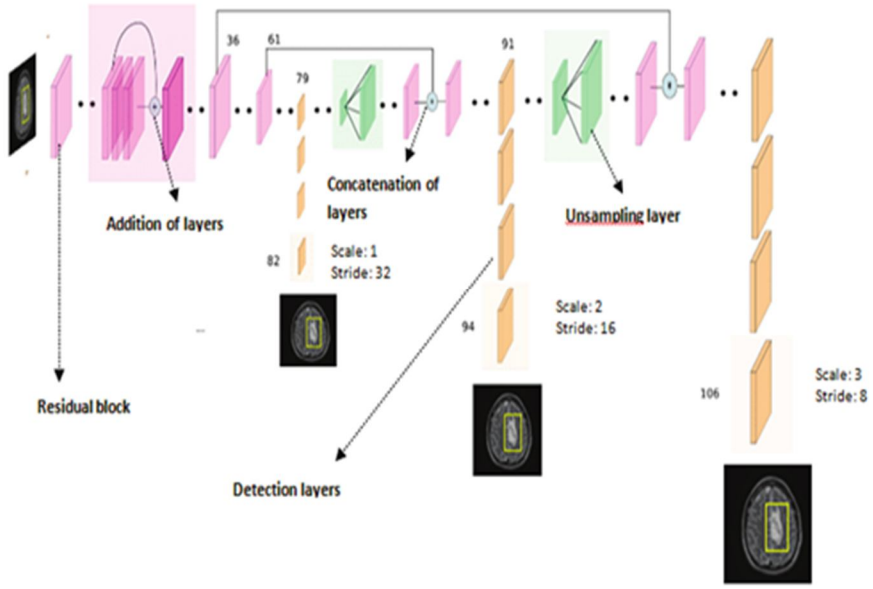


Fig. Yolo V3

A. Our System Works a Following Format

The data containing the MRI images and the labels are processed. In processing the Images are converted into the arrays and the labels are converted into a standard format. By the time image gets to 79 layer it is downscale by 32 times and then is upscaled by two times and again the same for step 3. Processed Images and weights are transferred to the yolo algorithm for training the model. . YOLO stands for You Only Look Once. It is one of the current advanced algorithms when you need real-time (in milliseconds) class detection and class prediction of this detected object. It has a total of 106 layers. The best advantage of this model is that it predicts in three scales (in layer — 82, 94, 106). And at the same time, the images will be reduced by their dimensions to 52 X 52, 26 X 26, 13 X 13 in these layers. The feature extractor in YOLO V3 (also called Darknet-53) alone has 53 separate layers (out of a total of 106 layers). The Yolo algorithm requires the following data files: The data files, the configuration file, the transferred weights. Based on the transferred weights and the configuration file the weights for detection is been trained. In Yolo the feature engineering is done on the data. The processed data is transferred to the CNN architecture specified in the configuration file. We have trained the yolo weights for 4000 iterations. In these the weights for each 1000 epochs are saved in the back up file. The Best weights, the Last weights are also saved in the back-up file according to the weights performance the best weights can be selected for the application.

V. DATASET DESCRIPTION

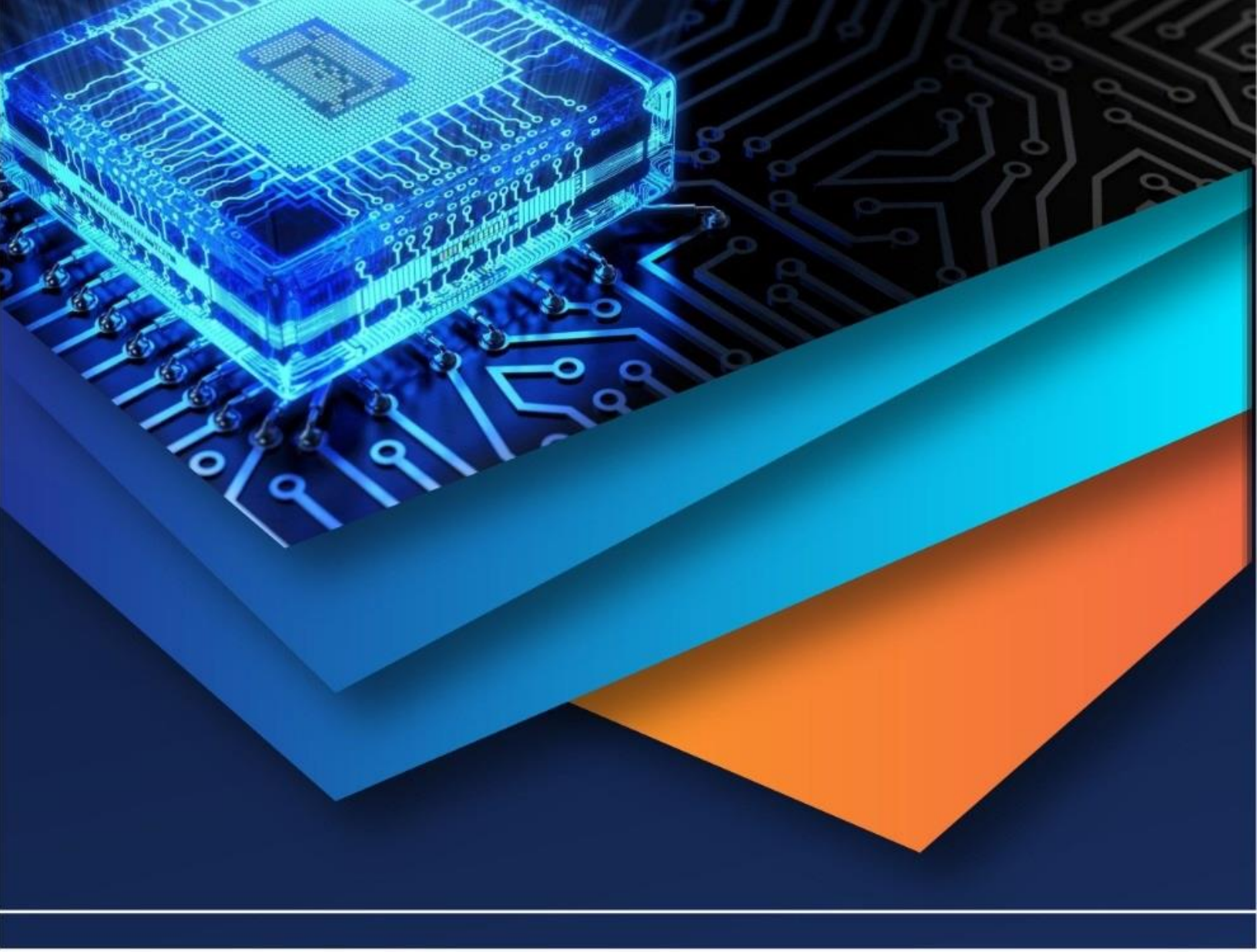
The dataset used in this article is retrieved from the Kaggle website. Data consists of images and labels. Images are in JPG and PNG format. These images are MRI scans of the brain. These images are high resolution images. These images are associated with labels. The labels consist of the location of the tumor in the brain. The label contains the center, width and height of the tumor, if the labels are not in this format, then they would be in the format of coordinates, these need to be converted to the format center, width and height. The pictures are from three different axes. The images are in JPG format and the image dimensions are 512 x 512. These images are converted to arrays using Open-cv, the images are read using Open-cv and read as grayscale images.

VI. CONCLUSION

A brain tumor is a disease in which abnormal cells in the brain multiply uncontrollably. Early treatment plays an important role in a patient's life. The most common method of tumor detection is MRI images. Manual tumor detection is very time-consuming and prone to human error. In our study, we used machine learning methods to detect a tumor in the brain. In this Proposed system we have studied brain tumor and types of brain tumor. We have studied how to fully automate the brain tumor detection using ML DL techniques. We have further studied the Computer Vision, OpenCV. We have precisely studied about YoloV3 algorithm. We can use the yolo object detection algorithm to predict the class if there is a tumor in the brain (positive and negative) and the location of the tumor in the brain. the darknet framework is used to implement the yolo algorithm and can select the best performing weights based on the error metrics of IOU and Map. These weights can be highly trained and can be used for other medical concepts. These yolo tumor prediction models have high performance for image class prediction as well as tumor localization.

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