International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-6, April 2020

An Effective Classification of Brain Tumor using Deep Learning Technique

Dr Balamurugan A, Siamala Devi S, Rajakumar G, Sreegandh S, Vivek S

Abstract: ***Health experts have increased taking advantage of the benefits of most modern technologies, thus generating a scalable improvement in the health care area. Because of this, there is a paradigm shift from manual monitoring towards more accurate virtual monitoring with minimum percentage of error. Advances in artificial intelligence (AI) led to exciting solutions with high accuracy for medical imaging technology and is a key method for enhancing future applications. Detection task of brain tumor is difficult in the medical field. Detection of brain tumors manually is time consuming and requires large number of MRI images for cancer diagnosis. So, there is a need for automatic brain tumors detection from Brain MR Images. Deep learning methods can achieve this task. Different deep learning networks can be used for the detection of brain tumors. The proposed method comprises a classification network which classifies the input MR images into 2 classes: one with tumor and the second without tumor. In this work, detection of brain tumor is done via classification by retraining the classifier using the technique known as transfer learning. The obtained result shows that our method works better than the existing methods. The most purpose of this project was to create a deep learning model that will classify if a subject features a growth or not based on MRI scan. I used the VGG-16, Inception v3, and Resnet.***

Keywords: ***Brain MR images, classification, deep leaning, Detection.***

I. INTRODUCTION

Brain tumors are one of the deadly cancers which can last longer and can have a psychological impact on patients. And the brain tumor needs the costliest care than any other cancers. The brain tumors can be classified into 120 types. And in this work, we are dealing with astrocytoma which is a part of gliomas [7]. The astrocytoma is the most commonly seen brain tumor which affects the glial cell of the brain.

The glial cell is a neurological cell that is present in the brain for providing nutrition to the neurons. Based on the grade of cancer cell the astrocytoma can be classified into 4 types.

Revised Manuscript Received on April 30, 2020.
***** Correspondence Author
Dr. A. Balamurugan*, Professor & Head/ Computer Science and Engineering, Sri Krishna College of technology, Coimbatore, Tamilnadu.
Dr. S. Siamala Devi, Associate Professor in the department of computer science and Engineering. Sri Krishna College of technology, Coimbatore, Tamilnadu.
Rajakumar G, Department of Computer Science and Engineering.
Sreegandh S, Department of Computer Science and Engineering.
Vivek S, Department of Computer Science and Engineering.

GRADE 1: These types of tumors grow really slowly and they won't spread to other tissues. They can be cured by surgery. GRADE 2: These types of tumors are more likely to slow growth and they won't spread to other tissues but there is chance for the return of the tumors. [6] GRADE 3: These tumors are more lethal than the above types and they are more likely to fast-growing and rapid cell dividing. [6] GRADE 4: These types are the extreme worse cases of tumors. Here the tumors are actively dividing and they do have blood vessels around the dead tissues. In the above types, grade1 and grade2 are not malignant but the others are malignant Cells. [5][6]The cause for astrocytoma is unknown even though there are some risk factors such as age, continuous exploration to radiation and family history of gliomas. The diagnosis methods usually followed by the hospitals are NEUROLOGICAL EXAM: Here the doctors check your vision, hearing, muscle strength, reflex, etc. and also press the nerves that connect your eyes and brain. MRI: The MRIs are taken from large machines with strong magnets connected to computers to take detailed pictures of the brain. CT SCAN: The x-ray machines[8] are connected to the computers to take the serial pictures of the brain. SPINAL TAP: In the spinal tap, the doctor may remove some cerebrospinal fluid from the spinal cord. Using this they can identify the tumor. BIOPSY: The removal of tissues for checking the tumor is called biopsy. MRI is more widely used than the CT scan because the brain is filled with soft tissues and the MRI is focused on soft tissue but whereas CT are focused on hard tissues [7]. And the accuracy of detection depends on the radiologist. If the radiologist is inaccurate in his work it will affect the accuracy of the detection so we are introducing deep learning techniques for the efficient detection of the brain tumors and corresponding network for efficient pre-processing and segmentation of the MRI[9]. A few months back news was reported by the New York Times stating "Failure to Diagnose Brain Tumor[10] leads to $1.4 Million Verdict". A child was suffering from a headache, and his parents took him for diagnosis. During the primary check-up, the doctor couldn't find the cause of a headache. So, he suggested taking an MRI scan. Once the result was out, both the radiologist as well as doctor failed to find a growing tumor inside the child's head. So the doctor prescribed the medicine for a headache. Three months later the child had lost his eyesight so suddenly. On detailed analysis, it was found that the child was suffering from a brain tumor and the child has lost his eyesight as the side effect of this.

The family filed a case against the doctor and the radiologist who did the preliminary analysis and the case was charged for medical negligence. Once the court called for hearing, in defense, the doctors argued that the delay itself was so brief that even if a tumor had been timely and properly diagnosed, the child would have still lost his eyesight.

The doctors also supported their point that there was no way that the tumors could have grown to that extent that in between the time of the delay and recent discovery.

II. RELATED WORKS

Generally the methodologies used for the effective classification of Presence of Brain tumor in MRI images of the patients and their accuracy rates are unit studied and a comparison is formed[3].

A. INCEPTION V3 CLASSIFIER

Inception V3 classifier has varied options like factorizing convolutions to cut back the amount of connections/parameters while not decreasing the network potency, effective grid size reduction , etc. The main purpose of the tool was achieved by using it for Transfer Learning in image classification.

Transfer learning is a process where you can transfer the weights learned on training to the next training sets where we use batch processing and a huge data-set for training. This process reduces time and requires fewer data to train on to high performance.

B. VGG16 CLASSIFIER

VGG 16 classifier expanded as Visual Geometry Group consists of 16 layers is a pertained model of convolution neural network[11] on more than a million images from the image network database. The network has a fixed input image size of 225 by 225. The pretrained VGG16 network is returned by VGG16 function. By just loading the convolution models leaving the fully connected layers we can make our classifier adapted to arbitrary input sizes.

C. RESNET METHOD CLASSIFIER

The ResNet method classifier can train up to thousands of layers and still achieves performance. The core plan of ResNet is introducing an alleged identity route association that skips one or additional layers. Once deeper networks[12]start convergence, a degradation drawback has been exposed with the increase in network depth, saturated the accuracy becomes, then degrades quickly.

D. DATA PREPROCESSING

Incomplete and reedy information area unit common in a very real-world information set as a result of the attribute wasn't vital at the time of entry, misunderstanding of field values, duplication or usage of the info for alternative functions[13]. The action composed in the pre-processing of a

Data set is the re-sizing of the original images into a valid size (224 x 224). So initially, we processor the data set to avoid various inconsistent and missing values for our study. [1] [2].

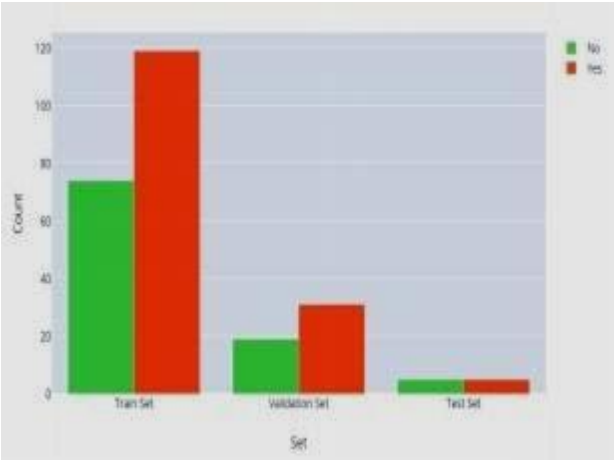

Fig. 1. DISTRIBUTION OF CLASSES AMONG SETS

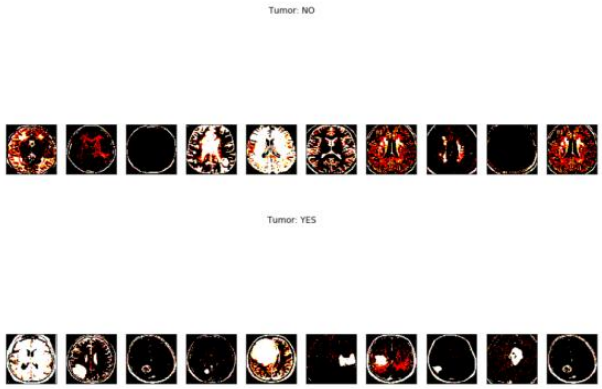

Fig. 2. Resizing Images to (224,224)

E. DATASET

This data-set contains brain MRI images together with manual FLAIR abnormality segmentation masks. These images were obtained from TCIA (The Cancer Imaging Archive)[4]. They correspond to 120 patients added in TCGA (The Cancer Genome Atlas) lower-grade gioma collection with at least FLAIR (Fluid-Attenuated Inversion Recovery) sequence and genomic cluster data available. It consists of MRI scans of two classes: NO - no tumor, encoded as 0. YES - tumor, encoded as 1.

III. DEEP LEARNING CLASSIFIERS

A. INCEPTION V3 CLASSIFIER

Inception V3 created by Google is the third version in a series of Deep Learning Convolution Architectures. Inception v3 is mainly used as an image recognition model that has obtained accuracy of 78.1% on ImageNet data-set. The model is the accumulation of various ideas gathered and developed by different researchers over many years. There are two parts of Inception-v3 (given in fig 3)

- Feature extraction part with a convolution neural network.
- Classification part with fully-connected and SoftMax layers.

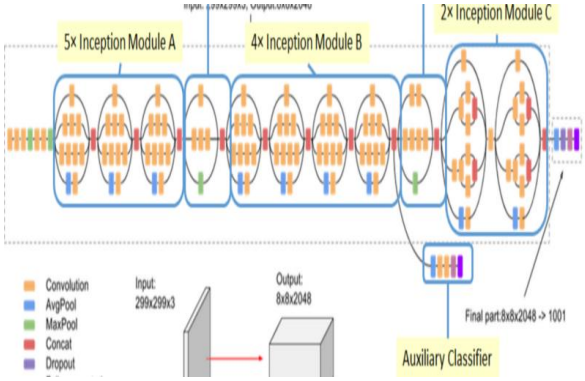

Fig. 3.Inception V3 architecture

B. VGG16 CLASSIFIER:

It has the advantage over Alex Net by changing large kernel size filters (11 and 5 in the first and second convolution layer) with kernel size filters of several 3X3 layer one after another (represented in fig 4).

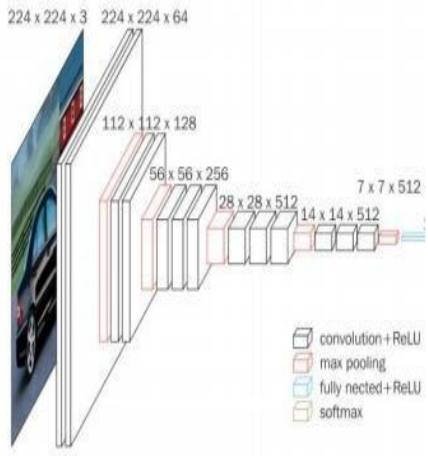

Fig. 4.VGG16 architecture

With a given receptive field(output depends on the effective area size of the input image) several stacked with small size kernel is better than that of one with a larger size kernel because several nonlinear layers, The complex features are learnt from the increasing depth of network and also cost effective.

VGG16 may be a convolution neural net (CNN) architecture .It is thought-about to be one in every of the superb vision model design until date. Most original factor regarding VGG16 is that rather than having an oversized variety of hyper-parameter they centered on having convolution layers of 3x3 filter with a stride one and forever used same cushioning and maxpool layer of a pair ofx2 filter of stride 2. It follows this arrangement of convolution and Georgia home boy pool layers systematically throughout the total design. Within the finish it's a pair of FC (fully connected layers) followed by a softmax for output. The sixteen in VGG16 refers to that has sixteen layers that have weights. This network may be a pretty giant network and it's regarding 138 million (approx.) parameters.

C. RESNET METHOD CLASSIFIER

ResNet follows VGG's full 3×33×3 convolution layer design. The residual block contains two 3×33×3, the output channels have the same number as convolution layers. Each convolution layer is followed by the batch of the normalization layer and a ReLU activation function. Adding the input directly by skipping those two convolution operations before the final ReLU activation function is activated. This kind of design requires that the output of the 2 convolution layers be of an equivalent shape because the input in order that they will be added together. If we need to change the number of channels or the stride, we need to give an intro to an additional 1×11×1 convolution layer to transform the inputs into the required shape for the addition operation. Images are 64 x 64 x 3 (3-channel RGB images).We have a total of 2 classes. ResNet will perform (64, 128, 256, 512) CONV layers stacked (3, 4, 6), which implies that: The total of 64 filters are obtained from first CONV layer of ResNet.

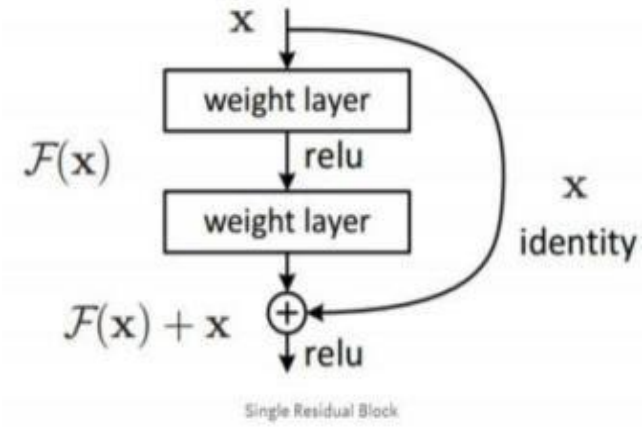

Fig. 5. ResNet architecture

The 32, 32 and 128 CONV filters must be learnt by the three CONV layers respectively in each residual model. We then reduce spatial dimensions. We then reduce the spatial dimensions. Next we stack sets of four residual modules, where each of the three CONV layers will have (64, 64,256) filters. Finally spatial dimensions are reduced. So that we can stack six sets of residual modules, where each CONV layer learns (128, 128, 512) filters. Before average pooling the spatial dimensions are reduced and a softmax classifier is applied (represented in fig 5).

IV. PROPOSED FRAMEWORK

The below flow diagram represents the proposed flow of work. The data collection is defined as the first phase of the project, nothing but loading datasets. The next stage is nothing but preprocessing of datasets. It performs the operation like ensuring no redundant data and resizing the images (data). Next comes the analysis methods which involve the VGG16, RESNET, INCEPTION V3 algorithms. It is used for training and validating huge datasets to provide accurate results. Gaining insights is nothing but getting the accurate result of which algorithm provides high accuracy. The final part is displaying results.

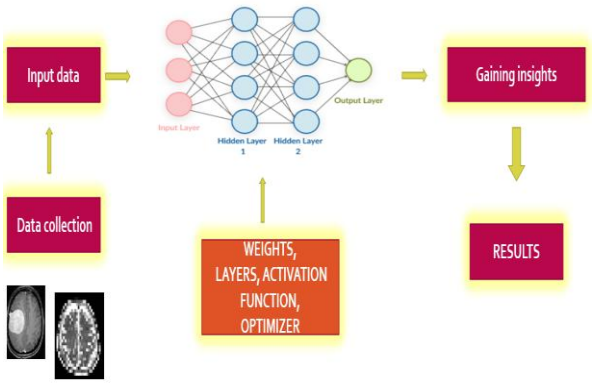

Fig. 6.Proposed System

V. RESULTS AND OUTPUT

Thus by using trending deep learning classifiers the proposed system provides better accuracy than the existing system in terms of Train Loss and accuracy and attest loss and accuracy. The results are shown in fig 7, 8, 9.

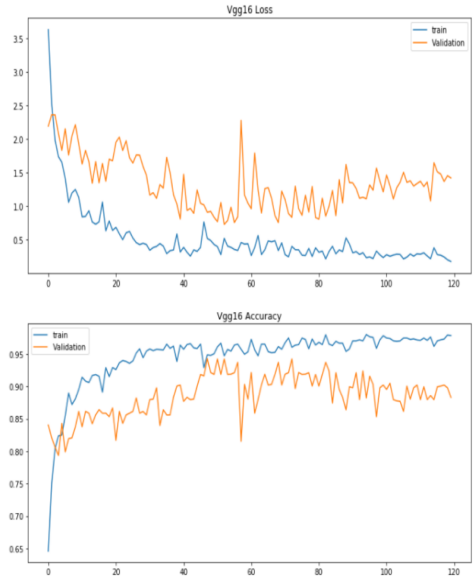

Fig. 7.VG16 results

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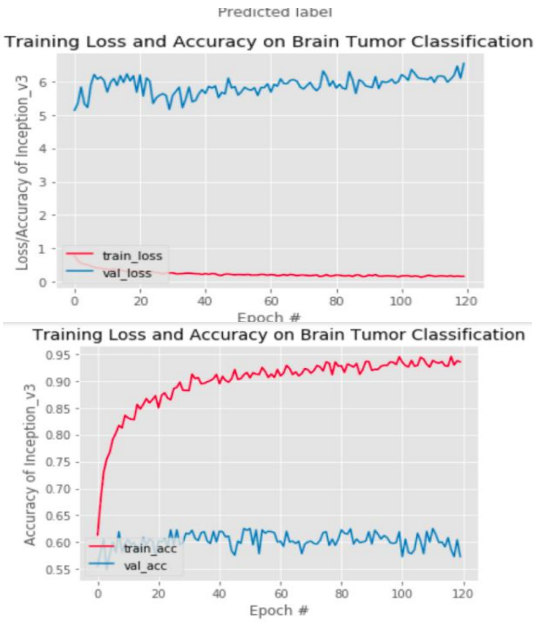

Fig .8.Inception V3 results

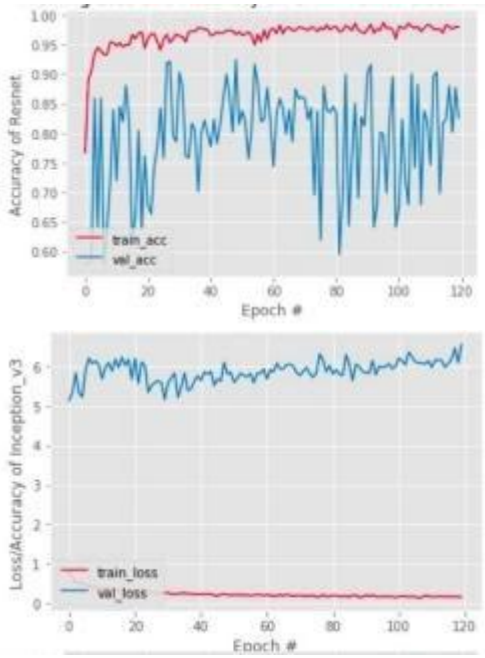

Fig. 9.ResNet results

Table- I: Result percentage

	VGG 16	Inception V3	ResNet
Train accuracy	98%	90%	6%
Test accuracy	88%	57%	82%
Train loss	1.42	0.24	0.38
Test loss	0.151	6.53	1.8
Epoch	50	50	50

For the given dataset, the VGG16 gives highest accuracy result of 88% (given in table I).

VI. CONCLUSION

Medical imaging techniques are progressively applied in clinical apply and analysis studies. This project is a deep Learning model classification problem (to predict whether the subject has a brain tumor or not).

The accuracy will be Increased by larger number of train images or through model hyper parameters tuning.

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AUTHORS PROFILE

Dr. A. Balamurugan is currently working as Professor & Head/ Computer Science and Engineering, Sri Krishna College of technology, Coimbatore, Tamilnadu. He has got more than 25 years of academic experience and he has published various research papers in reputed journals. He is an active member of various professional bodies.

Dr. S. Siamala Devi is working as Associate Professor in the department of computer science and Engineering. Sri Krishna College of technology, Coimbatore, Tamilnadu. She has got 10 years of academic experience.

Rajakumar G, UG student in Sri Krishna College of Technology in the Department of Computer Science and Engineering.

Sreegandh S, UG student in Sri Krishna College of Technology in the Department of Computer Science and Engineering

Vivek S, UG student in Sri Krishna College of Technology in the Department of Computer Science and Engineering.