Original Article

Brain Tumour Patient Intensity Identification Using Artificial Neural Networks

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Abstract

Brain tumor classification is a difficult task for manual diagnosis system in the health care industry. The proposed paper has examined the artificial intelligence deep learning algorithms to perform the classification process. The process has been done by using Support Vector Machine algorithms and the same process has been done by using Artificial Neural Networks process. The training data is collected from hospitals and converted the MRI images into JPEG images and used in the comparison and classification of data. The paper has examined more than 4000 images to perform the classification using these two algorithms. The results were extracted and compared. The comparative results revealed that the classification process for brain tumor disease intensity with the distinct grades. The results were evaluated and found that the classification process done using the ANN has produced much better and faster results than SVM algorithms.

Keywords: Support Vector Machines, Artificial Neural Networks algorithms, Image processing, Brain Tumor classification process.

INTRODUCTION:

Brain Tumors can be identified with the help of Magnetic resonance Imaging scanning. The MRI scanning can be examined by the brain tumour specialist and then the brain tumour classification can be done. In this process the patient is classified into four stages [1]. The brain tumour classification is called Bio-medical classification with Grade A, B, C, D and normal state. Detection of brain tumour identification with distinct classes would be difficult and sometimes erroneous. MRI images are in thousands in number and every piece of brain can be scanned and formulate the images. While distinguishing the size of the brain tumour the specialist doctors can be taking more time in diagnosis the disease intensity [10].

The image evaluation and decision of the radiologist and neuro-specialist could be sometimes leading to error and wrong diagnosis. To avoid this confusion the classification process has been automated with computer aided process. This process can be done with many methods and using different algorithms. Many research works have been used different algorithms for the identification of Brain Tumour intensity. In these algorithms Artificial Neural Networks algorithms have given more accuracy and significant less time in detecting and classifying the images in different grades. The proposed research work is depicting the classification process using Artificial Neural Networks and Support vector machine process. Finally the processes conducted by these predominant algorithms are compared and revealed the fastest automation process for classification of images [4].

The automation process of detection of MRI images can be done in a distinct process. The process is converting the existing MRI images into jpeg or png images. MRI images are considered to be large images. These images are taking more than mega bites of space and processing time also more. Conversion of MRI images into PNG or JPEG is the preliminary process for this automation process. The conversion process is essential to speed up the automation process and the image classification can be done within seconds [5].

In this research paper the automation of classification of Brain Tumour images is incorporated with the Support Vector Machine Algorithms as well as with the help of Artificial Neural Networks algorithms. Once this automation process is completed both results would be captured and compare the results. The main goal of the research paper is to demonstrate the automation of process with the help of two algorithms implementation and prove that the ANN algorithms are better than SVM algorithms utilisation processes.

LITERATURE REVIEW

Brain Tumor classification is connected with different kinds of brain tumors identification with area of the tumor it has occupied in the brain segment. It can be calculated by the neurotic specialist. But the manual detection is some times erroneous. In this context the quantitative analysis of MRI brain tumor would provide the useful key indicators of disease progression. According to the American Brain Tumor Association and World Health Organisation the most common

grading system can be measured with the grade I to Grade IV. These grades are going to reveal the malignant tumor types brooding inside the brain [4].

Brain Tumor detection through MRI images can be done with the image processing and image comparison. The process is initiated with the conversion of MRI images into JPEG or PNG image formats. The second one is collecting previous patients MRI images and process the images into JPEG. Then these images have to be classified into Grades. The final processes is the targeted MRI image should be compared with the previous images and classify the image with grading[5]. Kharrat et.al., (2015) stated in his research work about the brain tumor classification with the help of support vector machines combined with meta-heuristic method. In this method the MRI images are converted into JPEG images and process the classification process much easier than manual process. This process could get the results of classification of images with distinct Grading I to IV with in seconds. This process has attained nearly 83.5 percent of accuracy in classification process [11].

Al-Ayyoub et.al.,(2012) presented that the brain tumor classification can be done with the help of machine learning approach. It was published in ACM international conference. The gist of the research is that machine learning algorithms enriched with artificial intelligence can perform much better than any other automation processes in classification of bran tumor diagnosis with distinguished Grades [15].
A research work has presented that the brain tumor classification can be done with the help of Support Vector Machine algorithms enriched with deep learning concepts and techniques of Aritificial Intelligence. This concepts has superseded all brain tumor classification process with image processing and comparison [14].

METHODOLOGY

According to World Health Organisation the brain tumors have been classified into 4 grades. These are Grade I, Grade II, Grade III and Grade IV. Basically the tumors are classified into many varieties. These tumors identification is predominant to diagnosis the disease. Most commonly affected tumors are astrocytic and oligodendroglia tumors, Ependymal tumors, Choroid Plexus tumors, Neuronal and mixed neuronal-glial tumors and tumors of the pineal region. If any one of these tumors are identified in the MRI scanned images the classification done with Grade I, Grade II, Grade III and Grade IV. Distinct variety of tumors are traced and identified in different grades. Identification of distinct tumors would be helped to classify the intensity of the disease. World Health Organisation has given a list of tumors which can be identified in different grades [16].

Out of all these grades Grade IV is most advanced stage where the patient need to be kept in an intensive care and survival is questionable. If no tumour is identified in the MRI it should also denote the stage as Normal Grade. Hence the total classification should be done in five grades including normal. In MRI scans different sizes of tumors can be identified. Based on the size and place of the brain the brain tumor classification can be done. The important molecular markers are the identification marks in classification of grades of the brain tumor disease intensity. In this study the brain tumor images with different grades are taken and kept in the training folder to provide the significant identification and to classify the testing images. Based on the grades stored in the training folder the testing images will be classified accordingly. The brain tumors are more than 114 types. Distinct brain tumor is classified into different grade. Hence all these images which have 114 types of tumors with classification of Grades are need to be stored in the training folder[11]. When new patient is coming for diagnosis the jpeg image will be sent to testing folder which is going to keep the image for classification and image processing. The testing images will be compared with pixel by pixel with the images available in training folder. When the image is matched with any of the images stored in the training folder then it will be classified into the Grade specified with the matched images in the training folder [11].

In this methodology Image processing and image comparison is playing a vital role. In this process two folders are created and used for the image processing. Folder one is to store different varieties of brain tumor images which are already classified into distinct grade. The second folder is testing folder. This folder is used to take the testing image. The image is formulated from MRI Scanning. This image is need to be classified with different grades. Based on the grade the patient brain tumor intensity is judged. The image is compared with every pixel with the images stored in the training folder. The image comparison with thousands of images kept in training folder will be taking more time and some times the image comparison may breakdown. To over come this difficulty Artificial Intelligence is used.

SUPPORT VECTOR MACHINES:

Support Vector Machine can be defined as one of the supervised machine learning algorithms in Artificial Intelligence. It is rich with the capability to perform the classification, outlier detection and regression process with great deal of efficiency. It can read and understand the set of images which are need to be compared and perform the classification of a target image with the image comparison and image processing. It is enriched with artificial intelligence deep learning algorithms to perform the classification with a great deal of swiftness [13].

The process incorporated by SVM is in three stages. In the first stage it process the concepts or images to be processed from the Sklearn. svm. It imports the concepts into its SVC# ”Support Vector Classifier”. In the second stage the classifier concept will be incorporated on (SVC) (Kernal=’Linear’, random_state=0) concept. This concept will read every image

pixel by pixel and store the image classification with different grades. In the third stage the Classifier. fit (x train, Y_train) concept will be implemented to classify a new image which is need to be classified. In this stage prediction is playing a vital role in distinguishing the classification of the targeted image with distinct Grade. This prediction is done with a great accuracy[14].

Using this algorithm, the training folder will be filled with more than 114 images and the testing folder will be supplied with one image. After implementing the SVM algorithms the test results were extracted.

ARTIFICIAL NEURAL NETWORKS:

Artificial Neural Network [ANN] is regarded as a special algorithm which is developed for biologically inspired computing with artificial intelligence code. It is developed with simple and highly interconnected processing elements for simulating the human brain working process. This algorithm is specifically working on the training data which is going to energise the working model to classify any image with in fraction of seconds. It is working with the nonlinear vibration control of 3D irregular structures. This algorithm can develop the prediction and classification methods from unlimited images and perform the classification with high accuracy and great speed [14].

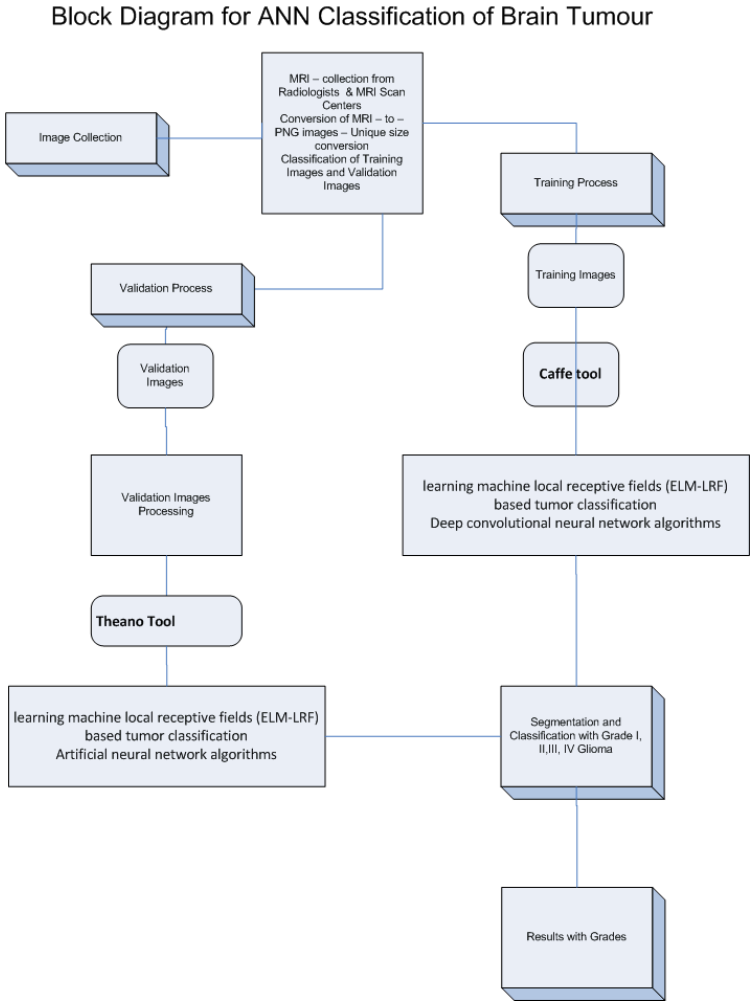

Figure 1 Block Diagram

ANN is basically working with two predominant concepts. These are namely Feedforward Networks and Feedback Networks. The feedforward networks are used for transmitting the signals in one direction without any loop towards the output layer. This is used for extensively for pattern recognition [6]. This is functioning with the single input layer and single output layer. This functionality of the layer is to learn the concepts at the time of training. At the time of operating period it acts normally until it fully trained with the concepts. This is how it can take every pixel of every image into the control and stores in the layer of its feedforward networks. The second phase is feedback networks. This network is an interactive network to use their internal state to process the testing image. The layers which have stored the pixels of every image will be processed and compared with any loop. It will take very less time to process the identification and classification [10].

The mathematical expression for ANN can be considered as here under.
Let us assume N is the name of a network with e number of connections, m inputs and n outputs.

Below, x1,x2,..denotes vectors in R^m , y1, y2….. vectors in R^n, and w_0,w_1,w_2, ….. vectors in R^e. These are called inputs, outputs and weights.

The network corresponds to a function $y=f_N(W_1,X)$ which, given a weight w, maps an input x to an output y.
In supervised learning, a sequence of training examples x_1, y_1),..., (x_p,y_p) produces a sequence of weights $w_0,w_1,….w_p$ starting from some initial weight w_0 usually chosen at random.

These weights are computed in turn: first compute wi using only (x_i, y_i, w_{i-1}) for i=1, …, p. The output of the algorithm can be considered as w p, giving a new function $x \rightarrow f_N(w_p, x)$ The computation is the same in every step of the algorithm. Hence the case *i*=1.

W_1 from (x_1, y_1,w_0) is computed by a variable weight w and implementing gradient descent to the function $w \rightarrow E(f_N(w, x_1), y_1)$ to find a local minimum, starting at $w = w_0$.
The gradient descent can be represented by w_1

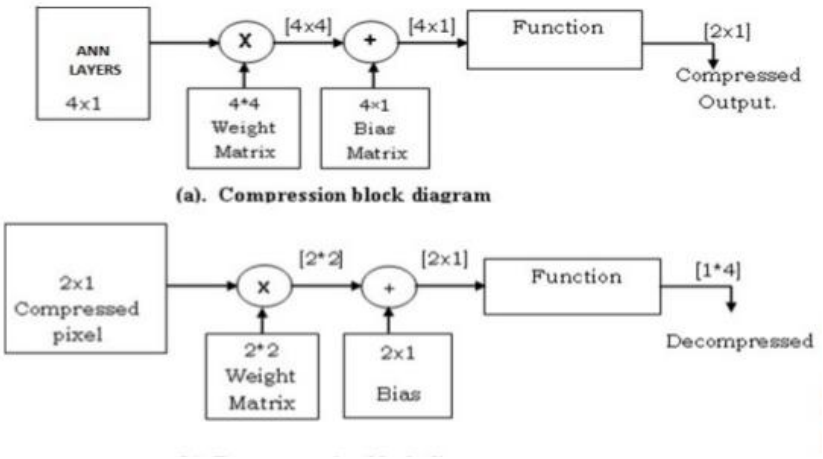

Figure 2 ANN Algorithms implementation for output generation

Propagation can be implemented in the following steps:
- Propagation forward through the network.
- Propagation of the cost
- Propagation of the output activation

ANN can create innumerable layers for its learning process. It can take as many images it can in the learning process and apply the same in individual input layers, neurons and weights. When the classification process is performed it crates the output layers isolated from the external world. Even it can process more than one image for testing instantaneously and perform the classification at a time. Hence the training folder can accept n number of images for training process. The output of the algorithm is given the output of results. The experimental results were extracted from Matlab Simulink by storing 980 images in the training folder and kept 10 images in testing folder. The following results have been obtained in the experiment.

RESULTS

SVM TEST RESULTS		
Grades Identified	**Images in Training folder**	**Time taken for classification**
1	144	12 SEC
II	144	13 SEC
III	144	11 SEC
IV	144	12 SEC
NORMAL	144	10 SEC

The results were extracted from the Matlab Simulink using SVM classification of image processing.

The following results are demonstrating the classification process with the ANN algorithm for image processing. The images in training folder are 980 and the process of identification has done with much more images kept in testing folder at a time classified. All the grades have been demonstrated for all images one by one with the stipulated time specified under.

ANN Algorithms classification			
Grades classification	No of Images in Training folder	No of images in testing folder	Time taken
I	980	10	8 sec
II	980	20	8 Sec
III	980	20	10 Sec
IV	980	10	9 Sec
Normal	980	10	8 Sec

EVOLUTION

The results were evaluated and proved that ANN algorithms are much better than the SVM algorithms for image processing in identification of intensity of disease classification with the Grading. The grading and classification has been done in ANN much better number of images in training folder. SVM process has taken 144 images with different brain tumor images with 4 grades. ANN algorithms process has taken 980 images in training folder and the testing folder has taken 10 images to 20 images and the processing of classification has done at a time for all the images and generated the results for 10 images or 20 images at a time with distinct classification.

Hence it is proven to be the ANN algorithms are much better than SVM in classification of images into different Grades.

CONCLUSION

Brain tumor classification is predominant in the field of health care. It is inevitable to implement an automation system to classify the images scanned from MRI scanning centers. This paper has thoroughly examined the implementation of ANN Algorithms of classification of brain tumor images to be diagnosed. The paper has examined two algorithms for performing the classification process for the images brought from scanning centers. The images are classified and demonstrated the results. The time duration for the classification of images into different grades done with the help of ANN Algorithms is much better than the classification process done with SVM algorithms.

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