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Brain Tumor Detection Using Deep Learning

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Abstract: *The anomalous development of cells in brain causes brain tumor that may lead to death. The rate of deaths can be reduced by early detection of tumor. Most common method to detect the tumor in brain is the use of Magnetic Resonance Imaging (MRI). MR images are considered because it gives a clear structure of the tumor. In this paper we proposed a novel mechanism for detecting tumor from MR image by applying machine learning algorithms especially with CNN model.*

The motivation behind this study is to detect brain tumor and provide better treatment for the sufferings. Usually, MRI scans are used for the detection of cancer regions in the brain. Positron Emission Tomography, Cerebral Arteriogram, Lumbar Puncture, Molecular testing are also used for brain tumor detection. In this study, MRI scan images are taken to analyze the disease condition. Objectives of this research work are:

i) identify the abnormal image

ii) segment tumor region.

Keywords: CNN, MRI, OS, PIL, SVM

I. INTRODUCTION

Deep learning is an extremely fast-moving field, and the huge number of research papers and ideas can be overwhelming. Even seasoned researchers have a hard time telling company PR from real breakthroughs. The goal of this post is to review those ideas that have stood the test of time, which is perhaps the only significance test one should rely on. These ideas, or improvements of them, have been used repeatedly. They are known to work.

The human body is made up of many organs and brain is the most critical and vital organ of them all. One of the common reasons for dysfunction of brain is brain tumor. A tumor is nothing but excess cells growing in an uncontrolled manner. Brain tumor cells grow in a way that they eventually take up all the nutrients meant for the healthy cells and tissues, which results in brain failure. Currently, doctors locate the position and the area of brain tumor by looking at the MR Images of the brain of the patient manually. This results in inaccurate detection of the tumor and is considered very time consuming.

A Brain Cancer is very critical disease which causes deaths of many individuals. The brain tumor detection and classification system is available so that it can be diagnosed at an early stage. Cancer classification is the most challenging tasks in clinical diagnosis. This project deals with such a system, which uses computer, based procedures to detect tumor blocks and classify the type of tumor using Convolution Neural Network Algorithm for MRI images of different patients. Different types of image processing techniques like image segmentation, image enhancement and feature extraction are used for the brain tumor detection in the MRI images of the cancer-affected patients. Detecting Brain tumor using Image Processing techniques it involves the four stages- Image Pre-Processing, Image segmentation, Feature Extraction, and Classification. Image processing and neural network techniques are used for improve the performance of detecting and classifying brain tumor in MRI images.

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II. AIM AND OBJECTIVE

Aim

The main aim of our project is to predict the binary target whether the person is having a Brain Tumoror not .

Objective

- To select and validate algorithms for proposed approach.
- To analyze the performance and compare with existing systems.

IV. LITERATURE SURVEY

Paper-1: A New Convolutional Neural Network Architecture for Automatic Detection of Brain Tumors in Magnetic Resonance Imaging Images

- Publication Year: 2022
- Author: AHMED S. MUSALLAM , AHMED S. SHERIF 2 , AND MOHAMED K. HUSSEIN
- Journal Name: IEEE Access: The Multidisciplinary Open Access Journal.
- Summary: This paper provides a new method for detecting brain tumor by deep learning method. Brain diseases are mainly caused by abnormal growth of brain cells that may damage the brain structure, and eventually will lead to malignant brain cancer. An early diagnosis to enable decisive treatment using a Computer-Aided Diagnosis (CAD) system has major challenges, especially accurate detection of different diseases in the magnetic resonance imaging (MRI) images. In this paper, a three-step preprocessing is proposed to enhance the quality of MRI images, along with a new Deep Convolutional Neural Network (DCNN) architecture for effective diagnosis of glioma, meningioma, and pituitary. The architecture uses batch normalization for fast training with a higher learning rate and ease initialization of the layer weights. The proposed architecture is a computationally lightweight model with a small number of convolutional, max-pooling layers and training iterations. A demonstrative comparison between the proposed architecture and other discussed models in this paper is conducted. An outstanding competitive accuracy is achieved of 98.22% overall, 99% in detecting glioma, 99.13% in detecting meningioma, 97.3% in detecting pituitary and 97.14% in detecting normal images when tested on a dataset with 3394 MRI images. Experimental results prove the robustness of the proposed architecture which has increased the detection accuracy of a variety of brain diseases in a short time.

Paper-2: Learning Methods of Convolutional Neural Network Combined With Image Feature Extraction in Brain Tumor Detection

- Publication Year: 2020
- Author: Weiguang Wang, Fanlong Bu , Ziyi Lin , And Shuangqing Zhai
- Journal Name: IEEE Access: The Multidisciplinary Open Access Journal.
- Summary: Computer-aided detection technology is less applied in brain tumor detection terminals, and it is difficult to eliminate the influence of various interference factors on the diagnosis results. In order to promote the application of computer-aided detection technology in brain tumor detection, this study based on convolutional neural network, combined with MRI detection technology to construct a model adapted to brain tumor feature detection. The main function of this research model is to segment and recognize MRI brain tumors and use convolutional layer to perform convolution operation to improve recognition efficiency and rate and combine artificially selected features with machine learning features. In addition, this article uses feature fusion to further improve the diagnostic results. Finally, this article designs experiments to perform performance analysis. The research shows that the model algorithm designed in this article has certain practical effects and can provide theoretical reference for subsequent related research.

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IV. METHODOLOGY

Data Collection and Preprocessing

In this project a dataset from www.kaggle .com is used. The name of the data set is "Br35H :: Brain Tumor Detection 2020". This dataset contains two sets of MRI images. Each set has 1500 images. One set contains brain MRI reports with brain tumor present and the other one has health brain scans.

As this data contains a total of 3000 images out of which exactly 50% are tumor less, this is balanced data and best suited for training the model.

Image Pre-Processing

The aim of the pre-processing step is preparing the brain images for further processing. This process mainly depends on the data acquisition device which has its own intrinsic parameters. Gray scale or 2D conversion is needed, if the raw data is in 3D. Median filtering is best suited for biomedical images to avoid noise. The dataset contains images in different resolutions. As part of the augmentation process, each image is rotated and scaled to a standard format. So, we have converted each image into 64 by 64 pixels, and also converted these raw images to RGB format using the PIL library for better segmentation. Once are images are scaled and converted to an array format, we have assigned 0 to images with no tumor and 1 to images with brain tumor. The following code snippet shows how preprocessing needs to be done.

Segmentation

In this step a digital image is partitioned into multiple segments. A particular region of the image is being separated from the background This step is very important for preprocessing Classification using CNN Segmentation. Thresholding and morphological operations (erosion, dilation, opening) are the simple steps to segment disease. But in the brain tumor images, the segmentation process at this level will not give the details of tumor regions.

The healthy images also have a similar intensity that resembles the tumor region. So, the segmentation process can be used to separate the skull of the brain. This Region of Interest (ROI) contains the tumor. OTSU based thresholding algorithm gives a segmented mask of the skull. Active contour method draws the boundary of the enclosed region. Second stage of segmentation can also be applied to the ROI to prepare the mask of tumor region. This method may not give good results in healthy images. This segmented image can be used to study the features of tumor region, which will help in the density estimation.

Feature Extraction

Computing the actual features can be analyzed to illustrate the behavior or symptom of the disease. The classification is mainly influenced with the feature selection. Common features are asymmetry, diameter, and border irregularity.

After applying the necessary convolution layers to the image and after segmentation is completed, only the main features are left in the image. This is shown in the following image.

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Sampling Data into Training and Testing sets

To divide the data into training and testing sets efficiently, we have used the train_test_split module from sklearn library. The ratio of training to testing set is 80 : 20.

Model Building

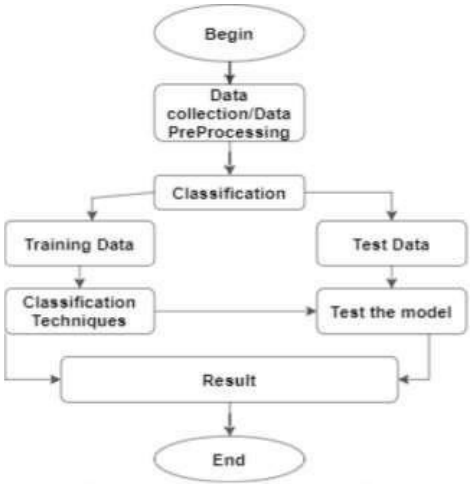
In this step we have built a CNN based model using the keras library of Tensorflow framework.

This model adds three convolutional layers using the Rectified Linear Unit (ReLU) activation function. The rectified linear activation function or ReLU is a non-linear function or piecewise linear function that will output the input directly if it is positive, otherwise, it will output zero.

It is the most commonly used activation function in neural networks, especially in Convolutional Neural Networks (CNNs) & Multilayer perceptrons.

It is simple yet it is more effective than its predecessors like sigmoid or tanh.

Graphically, it is represented as;



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V. RESULT AND ANALYSIS

There are many evaluation metrics to evaluate the model. We make use of accuracy to evaluate the model. Accuracy: Accuracy shows how well the model predicts the class. Mathematically accuracy is defined as the truly predicted instances divided by the total number of instances.

The test accuracy of this model is 96.66%

VI. ACKNOWLEDGMENT

We would like to take this opportunity to express our deep sense of gratitude to our project guide Prof. R. A Vasmatkar for guiding us in the right manner, correcting our doubts as well as giving us advice about design and solutions for the problems which we faced by giving her valuable time whenever we required while developing this project. We are especially grateful to our Head of Department Dr. M. P Wankhade for his valuable guidance, encouragement and for allowing us to use college resources and facilities. The acknowledgement will be incomplete if we do not thank our Principal Dr. S. D Lokhande, who gave us their blessings and motivation which has been highly instrumental in making our project..

VII. CONCLUSION

In brain tumor detection we have studied about image processing techniques likes image pre-processing, image segmentation, features extraction, classification,and also deep learning technique- CNN.

In recent years, magnetic resonance imaging (MRI) has proven to be an excellent technique for clinical research, with applications such as brain tumor detection. When applied to these MRI pictures, deep learning algorithms aid in the detection of the tumor. In this system we have detected that a tumor is present or not. If the tumor is present then model return's yes otherwise it return's no.

This system can be improved to support with a web interface. Detection of different diseases can be also identified from the MRI images. In the healthcare field, the system will be quite beneficial. The proposed approach can determine whether or not a tumor exists. However, in the future, the system could be improved to recognise a specific type of tumor and provide therapy accordingly.

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