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Brain Tumour Classification and Identification Using Deep Learning Neural Networks

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Abstract: Convolutional Neural Network (CNN)-based brain tumour detection is used to identify and categorise different types of tumours. Many scholars have studied and designed paths across this area over the course of many years. We've suggested a method that can identify and categorise various tumour forms. Since MRI scans the human brain without requiring any operations, they provide a comprehensive picture of the human brain's anatomy, which aids in the processing of the image for tumour identification. Misclassification results from human beings predicting tumours from MRI pictures. This inspires us to create the algorithm for brain tumour identification. For the purpose of identifying tumours, machine learning is helpful and important. Convolutional neural networks (CNNs), one of the machine learning algorithms, was used in this article because of their strength in image processing. Using CNNs and MRI data, we created a web application for the identification of brain tumours and the classification of their various forms, this web application contains about disease, treatments and famous doctors for treat this disease.

Keywords: Brain MRI Images, CNN Algorithms, Flask Framework, Web Application, Brain Tumour Detection, Treatments and Doctors.

I. INTRODUCTION

Medical photographs of different body parts serve a crucial role in diagnosis, treatment, and medical research as a result of the enormous advancements in the medical sector. Various imaging methods, including X-ray, fluorescence, and magnetic resonance imaging, are used in medical imaging (MRI). A tumour condition is prevalent and complicated in all of those photos. Therefore, one of the key areas of research in the medical profession is the identification of brain tumour diseases. Medical imaging data analysis is mostly used in the diagnosis of brain tumours. An essential stage in determining the patient's condition is an accurate and precise study of the tumour.

These many aspects, such as the doctor's training, experience, and visual fatigue, are crucial for making the right tumour diagnosis. And these diverse factors have an impact on how well tumour image analysis is done. Therefore, it is crucial to find photos of brain tumours. The size, shape, and location of the tumour may all be learned using Magnetic Resonance Imaging (MRI)[5]. The MRI-produced pictures are precise and accurate.

With the aid of MRI, diagnostic accuracy is significantly increased [5]. The use of the MRI helps to prevent thoracotomy procedures and serves as a guide for lesion location and surgical therapy. Three-dimensional multi-band imaging technique is used in brain MRIs [5]. Using the unused development sequence, we may retrieve the various tumour shapes in multi-model MRI scans. Different modes might show various aspects of a brain tumour. Basically, there are two categories of brain tumours: malignant and non-cancerous. Benign brain tumours are non-cancerous growths that remain in one location and do not spread throughout the body or the brain, making them less threatening to human health. Malignant refers to cancerous tumours that have spread throughout our body or in the brain quickly, posing a threat to our health. Cancerous brain tumours do not remain in one location. Because of this, it is crucial to forecast brain tumours early so that the patient may receive the proper care based on the kind of brain tumour (malignant or non-cancerous) [4].

This project maintains a system that makes use of computer-based methods to identify growth obstructions and classify the type of cancer using Convolution Neural Network Calculation for MRI images of distinct patients. For the detection of brain cancer in the MRI images of the disease-affected individuals, many types of image management techniques, such as image division, image enhancement, and component extraction, are used. Using image processing techniques, it is possible to distinguish between different stages of brain development. These stages are image pre-processing, image division, feature extraction, and classification. For work on the exhibition of recognising and defining cerebrum development in MRI images, picture processing and brain network approaches are used.

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II. RELATED WORK

The pre-processing of images in fundamental research is based on the dimensions of the picture, including its height, breadth, and the number of RGB channels (RED, GREEN, and BLUE, which stand for the colours), as well as its spatial properties. In order to detect and categorise the tumour, Ming Li, Lishan Kuang, Shuhua Xu, and Zhangvo Sha [1] used MR images, which reveal details on the size, shape, and location of human tissues. The prediction and classification processes were conducted out utilising the MR image and the supplied data. Many researchers have employed multi-model MR image-based brain tumour detection. In order to categorise tumour tissues into several groups, such as tumour tissues, edoema tissues, necrotic tissues, and normal tissues, brain tumour detection techniques are utilised. In the past 20 years, the problem of brain tumour detection has attracted a lot of attention since it is a difficult tumour to identify. Three kinds of brain tumour image identification by human involvement exist: completely automatic detection, semi-automatic detection, and manual detection. The manual detection is entirely manual and is capable of drawing the shape of a tumour by hand. Based on the manual initialization, semi-manual detection is performed. Additionally, there is no human involvement in the entirely automated detection.

III. PROBLEM DESCRIPTION AND SYSTEM ARCHITECTURE

The use of varied pictures in the medical profession nowadays is crucial for both research and the diagnosis of many diseases. Due to the frequent occurrences of brain tumours and their complexity, study on medical diagnosis data has thus grown significantly in importance. Today, brain tumour detection is a hot area for medical research. The many medical pictures of tumours that are accessible can be used to detect brain tumours. Accurate examination of the brain tumour photos reveals the patient's status. As a result, a variety of machine learning methods, including convolutional neural networks, are used to interpret the data on brain tumours that is accessible in the form of medical pictures (CNN). The size, shape, and location of the tumour are all shown by the MRI scan. The different machine learning algorithms will get those photographs as input. The prediction of brain tumours is critically important. The MRI pictures will be filtered during the pre-processing step, and smooth images will be provided as input to the machine learning method. Many researchers have employed multi-model MR image-based brain tumour detection. Using a method to identify brain tumours, tumour tissues are separated into categories such as edematous, necrotic, and normal tissues. Because of the unique challenge presented by brain tumours, tumour detection has attracted a lot of attention in the past 20 years. The two kinds of brain tumour image identification by human interaction are completely automated detection and manual detection. The semi-manual detection is based on the manual, while the manual detection is entirely manual based and capable of manually drawing the outline of a tumour. Chest x-ray, 3D multiband imaging, and other imaging techniques are used in brain tumour MR pictures. 3D multiband MRI provides the coordinate position of the lesion region by comparing the 2D and 3D images, which enables clinicians to precisely pinpoint the lesion area. In this paper we determined two kinds of brain MRI images. First one is tumour exits image and another one is normal or healthy brain MRI image.

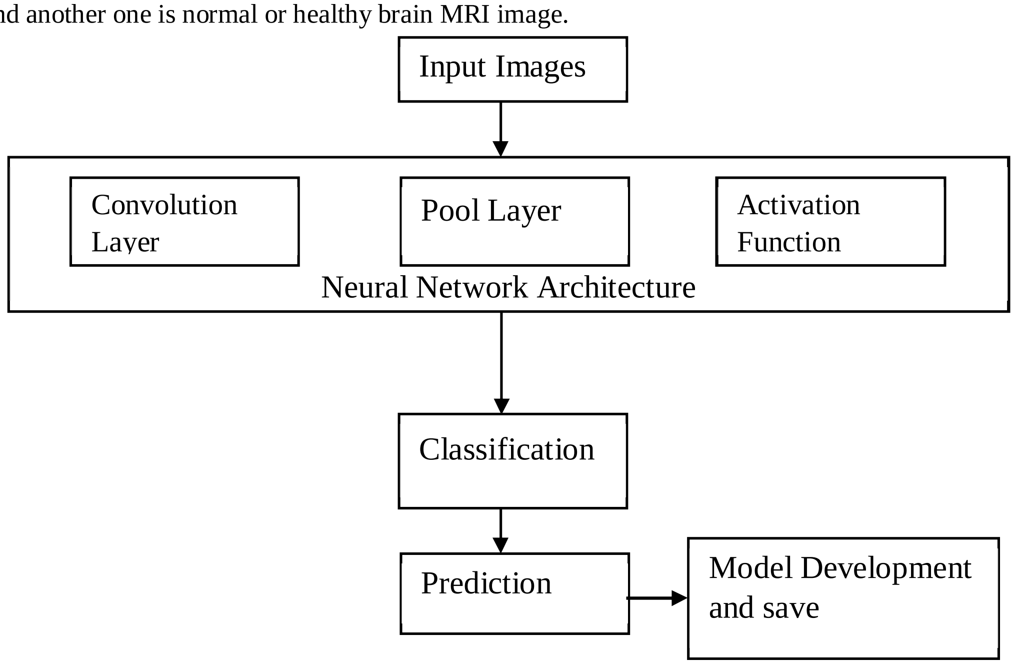

Fig 3.1: Architecture of the Proposed System

1) *Input Layer:* This model accepts a 2D MR picture as input. This MR picture is crucial since it will determine if a tumour is there or not based on that MRI. The Convolutional Neural Network will be given the MR images following the conclusion of pre-processing.
2) *Convolution Neural Network:* A machine learning method called CNN is widely utilised in signal processing. Additionally, for picture signals, additional convolutional processes are used to obtain the name of the Convolutional Neural Network. Convolution operations in CNN are mostly used to extract features from pictures. In essence, CNN is made up of fully linked layers, pooled layers, and numerous convolutional layers. Convolutional and pooling layers often alternate in the network's front section, with fully linked layers making up the back half.
3) *Activation Layer:* After the first and second layers of CNN, a branch called the activation function is concatenated. The three common activation methods are sigmoid, ReLu, and softmax.
4) *Pooling Layer:* Poling, which is an agglomerative statistical procedure of pictures, is used to minimise the amount of calculations. Pooling is mostly used to eliminate redundant data or information and to scale down feature maps. The feature map is obtained through the convolutional layer after the picture has passed. The main goal of the pooling procedure is to shrink the feature map's dimension and remove some unnecessary data, which lowers the workload on the computer and prevents over-fitting. After image processing, the CNN model predicts the tumour. After a tumour is found, it is simply classified according to its kind. It will categorise the tumour into two types: the first is an existing tumour, and the second is the absence of a tumour, based on observation or prediction. It will assist medical personnel in giving patients the right care. Following tumour categorization, the method pinpoints the tumor's position, which helps medical personnel treat patients appropriately. If surgery is required to remove the tumour, it will also be of great use to physicians.

IV. RESULT AND DISCUSSION

Python programming was used to accomplish the suggested method. To classify distinct photos, the Convolutional Neural Network (CNN) technique was used. We took more than 1000 MRI scans from the online dataset, using 30% of the photos for testing and 70% of the images for training.

Various measurement criteria were used to assess the performance of the suggested approach. Equations were used to calculate the accuracy.

The accuracy is computed as the ratio of Positive samples that were correctly categorised to all samples that were classified as Positive (either correctly or incorrectly). The precision gauges how well the model categorises a sample as positive.

$$\text{Precision} = \text{TruePositive} / (\text{TruePositive} + \text{FalsePositive})$$

The recall is determined as the proportion of Positive samples that were properly identified as Positive to all Positive samples. The recall gauges how well the model can identify Positive samples. The more positive samples that are identified, the larger the recall.

$$\text{Recall} = \text{TruePositive} / (\text{TruePositive} + \text{FlaseNegative})$$

The algorithm accurately assigns the negative term "specificity" to everyone who is actually healthy.

$$\text{Specificity} = \text{TrueNegative} / (\text{TrueNegative} + \text{FalsePositive})$$

The ratio of properly identified individuals to the entire group of subjects is what is known as accuracy. It makes the most sense to use accuracy.

$$\text{Accuracy} = (TP + TN) / (TP + FP + FN + TN)$$

TP = True Positive
TN = True Negative
FP = False Positive
FN = False Negative

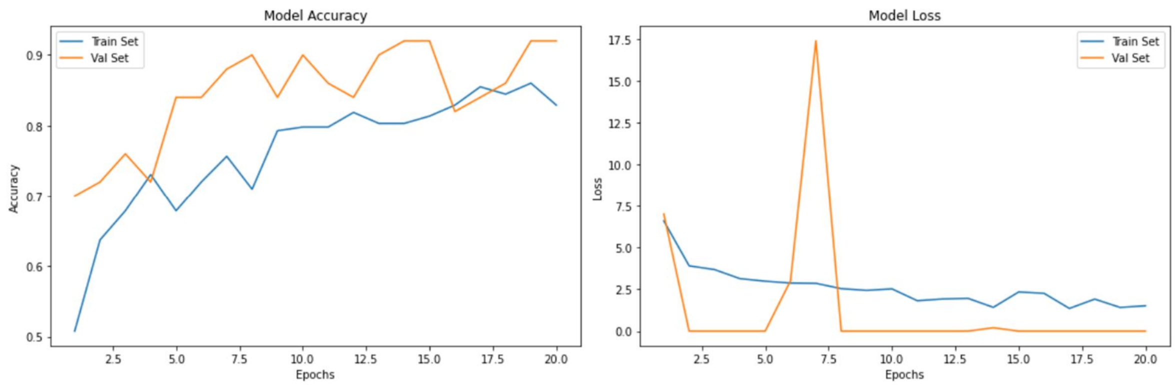

Fig 4.1: The Model Accuracy and Loss

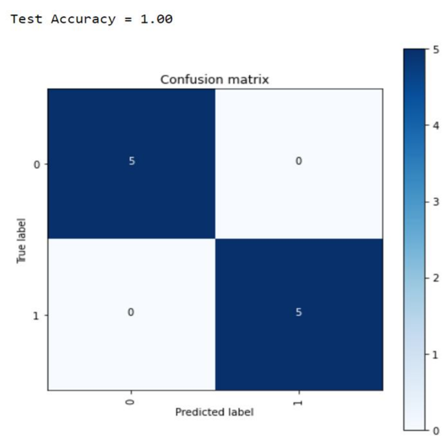

Fig 4.2: Confusion matric for Test Accuracy

V. CONCLUSION

As is common knowledge, one of the most hazardous illnesses is a brain tumour. It may result in a person's death. Manual processing cannot be used to identify this illness in its early stages. In order to identify tumours as early as feasible, we applied certain Deep Learning models in this research. The CNN method, which is crucial for image processing and classification, was employed in this study. Convolutional, activation, and pooling layers are the three primary layers of CNN. These layers are all linked, allowing CNN to analyse and interpret information to categorise pictures. The prediction process is based on classification. Another module, localisation utilising specialised object detection, is employed. Utilizing localisation, the affected part of the brain will be highlighted and the test accuracy reached 100% so it is good model.

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