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Conference Proceedings

Department of Computer Science & Engineering
PESITM, Shivamogga.

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National Conference On Emerging Innovations in Computer Science & Technology (NCEICT-2023)

ISBN: 978-81-963542-0-6

12TH MAY 2023

www.pestrust.edu.in/pesitm/nceict23

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Brain Tumor Detection using Deep Learning

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***Abstract*-The goal of this study is to identify brain tumors and improve care for people who are suffering. Tumors are the term used to describe the abnormal cell growths in the brain, while cancer is the term used to describe malignant tumours. Typically, regions of the brain with cancer are found using CT or MRI studies. For detection of brain tumors, further methods include molecular testing, lumbar puncture, cerebral angiogram, and positron emission tomography. Images from an MRI scan used to investigate in this study the illness state. The goals of this research are to (i) segment the cancer region and (ii) identify the abnormal image. The segmented mask can be utilized to evaluate the tumor's density, which will aid in treatment. A deep learning algorithm is utilized to analyse MRI pictures and find anomalies.**

Keywords—Brain Tumor;Python; Image Processing; CNN; Deep Learning:

I.INTRODUCTION

Early diagnosis and treatment of brain tumors contribute to earlier diagnosis, which lowers the mortality rate.Image processing has grown more prevalent recently and has become essential to the medical industry as well. Brain tumors are caused by abnormal cell development in the brain. Another name for a brain tumor is an intracranial neoplasm. The two different forms of tumours are malignant and benign. Based on visual characteristics and a contrast examination of the soft tissue, commonly, standard MRI techniques are utilized for distinguishing between different types of brain tumors.World Health Organisation (WHO) has classified over 120 kinds of brain tumors into four tiers based on their level of aggressiveness [1].

Brain tumor incidence is influenced by genetics, ionising radiation from cell phones,chemicals, head trauma, immunological variables like viruses, allergies, and infections, among other things[2].

Depending on the section of the brain that is damaged, symptoms are elicited by allcategories of brain tumors. The main symptoms may include migraines, convulsions, blurred vision, nausea, memory loss, mental changes, loss of balance, etc. [3].

The major classification of brain tumor is by the origin of the tumor, based on that it is classified as (i) Primary tumor – tumors those that originate within the brain itself.

(ii) Secondary tumor – known as metastatic brain tumors, which originate in other body parts and spread to the brain.The most common system used for brain tumor staging is the World Health Organization(WHO) grading system. The WHO grading system divides brain tumor into four grades based on tumor's growth rate and appearance under a microscope. The four grades are:

(i)Grade I – these tumors are least aggressive and are usually slow-growing. They are generally treated with surgery alone, and they frequently have a better prognosis than high-grade tumors. (ii) Grade II – this grade tumors are more aggressive compared to grade I and tend to grown and spread more quickly. They are treated with methods such as surgery, chemotherapy and radiation therapy. (iii) Grade III – these tumors grow generally faster than grade II. They consists of abnormal cells that are actively dividing and are likely to spread to the other parts of brain. The treatment typically involves the combination of radiation therapy, surgery and chemotherapy. (iv) Grade IV – these are most aggressive and malignant tumors. These tumors grow rapidly and have cells that are highly abnormal and active dividing. Treatment involves the combination of surgery, chemotherapy and radiation therapy, although the prognosis for grade IV tumors is generally poor.One machine learning method called deep learning instructs computers on how to react to circumstances just like people would. Using deep learning, a computer model may perform categorization tasks using images, sounds, or text. It has been demonstrated that deep learning algorithms can occasionally outperform humans. One of the well-known neural networks is an artificial neural network, which consists of a collection of simulated neurons. Each neuron serves as a node, and nodes are linked to one another by links[4]. The current approach for detecting the brain tumor is by using the CNN was utilized to develop efficient algorithm (application) to detect the presence of brain tumor.The algorithm is trained by series of brain MRI images and classified into yes or no.

II. LITERATURE REVIEW

According to Mihaela Lascu, Mircea Gurbin, Dan Lascu the methodof combiningDiscrete Wavelet Transform (DWT),

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ISBN: 978-81-963542-0-6

Continuous Wavelet Transform (CWT)and Support Vector Machine (SVM)[5].

According to Dr. Babu Anto P. andReema Mathew A.cancer area can be identified using segmentation of an MRI. Tumour size and location can be determined with the aid of radiological studies. In this case, segmentation is performed manually, which takes time. Anisotropic diffusion filters are used for the pre-processing. Support vector machines are utilized for the segmentation and classification [6].

Prastawa Marcel, Bullitt Elizabeth, have proposed that A number of pre-processing procedures are used to the image, including bias field correction,image registration, removing unnecessary brain tissues, noise removal, skull-stripping, and image enhancement. Other techniques, such as intensity normalisation and image resampling, are also an option [7].

Marzieh Ghahramani, Nabiollah Shiri, have proposed that 3D CNN-based classification and segmentation of brain tumours is proposed. The BraTS challenge datasets from 2015, 2017, and 2018 were each utilized as a separate dataset for validation. In this study, discriminant analysis (LDA), k-nearest neighbour (KNN),support vector machines (SVM), decision trees (DT) were employed for the purpose of comparison. with the feedforward neural network (FNN) as the main classifier. Accuracy, mistake rate, and duration were some of the factors that were looked at to gauge how well the suggested technique worked. Mini-batch accuracy was also estimated to evaluate segmentation performance. The results showed that the suggested approach outperformed the other classifiers in terms of regarding precision and frequency of errors [8].

Riddhi.S.Kapse, Dr. S.S. Salankar, Madhuri proposed that constrained architecture forecast with CNN for the complete technique. Instead of using CNNs to describe focal voxels for data image fragments within classes of brain tissue, initial fixes of names are extracted from sand precision patterns and then grouped by k-implies algorithm into N gatherings to create a mark fix lexicon of size N. The characterising of multi-level data model parts within unity of these groupings is then done using a 2D CNN. Whelps cubes rates of 83%, 75%, and 77% for the overall tumour, core tumour, and dynamic tumour areas are independently taken into account in this segmentation execution of the scheme [9].

Havaei M, Davy A, Farley W D, Biard A proposed approach involves a convolutional neural network (CNN) that processes both local details and larger contextual information of brain MRI images by extracting smaller patches and larger patches simultaneously. Specifically, patches of size 33 x 33 pixels are extracted for the local pathway and patches of size 65 x 65 pixels are extracted for the global pathway, centered around the same image location, to predict the label of the central pixel. Initially, a CNN processes 2D multi-modality global input patches of size 65 x 65 x 4 to generate output patches of size 33 x 33 x 5. Then, these output patches are combined with the local patches of size 33 x 33 x 4 and fed as input to a two-pathway CNN with convolutional layers containing 7 x 7 filters in one pathway and 13 x 13 filters in the other pathway, thus forming a single fully connected network. Various modified architectures of this proposed CNN model were also developed [10].

Alves V, Pereira S, Pinto A, Silva C A. proposed that the execution of segmenting brain tumours using more under CNN architectures was evaluated by CNN techniques. By inserting a small number of 3 x 3 estimated channels into the convolutional phases, this process is demonstrated [11].

GOALS AND OBJECTIVES

Image-based detection of brain tumors is of considerable interest in the medical field as it is a crucial aspect of disease detection. The objectives of our project are:

- To develop a system that is capable to detect and identify the presence of tumor
- Identifying the tumor with high accuracy
- Application with an intuitive and accessible usage
- Cost effective

III. SYSTEM DESIGN

Systems design is the procedure of defining a system's components, including modules, architecture, components, their interfaces, and data, depending on the requirements that have been given. It is the operation of creating, defining, and designing systems that meet the unique demands and requirements of an organisation or business, as well the various interfaces at which those components interacts with one another and the information that flows through the system. The purpose of the proposed work is to develop an efficient algorithm to detectthe presence of brain tumor. So, we are developing an algorithm to find the presence of brain tumor with high accuracy using convolutional neural network as shown in figure 1.

For the investigation of brain tumour identification, many bio-medical imaging records are available. Magnetic Resonance Imaging (MRI) and computer tomography (CT) are the common techniques for the detection oftumours, further methods include molecular testing, lumbar puncture, cerebral angiogram, and positron emission tomography. However, they are pricey. The basis of MRI is the idea that by detecting the presence of water molecules, both the radio waves and magnetic field may provide an inside image of human body. The first phase involves the acquisition of images through uploading the MRI scan images. Here MRI scan images are given as the input to the application. The second phase is pre-processing, the aim of pre-processing is to clean the data or image for further processing[12]. The third phase is segmentation where multiple segments are created from a

ISBN: 978-81-963542-0-6

single digital image. The backdrop of the photograph is being removed from a certain area. This process is very important for extracting the wildlife. The basic processes to segment an illness aremorphological operations (opening, dilation, erosion) and thresholding. However,segmentation process at this stage will not reveal the specific regions of the tumour in images of brain tumors. The intensity of the healthy photos is equivalent to the intensity of the cancer region. Therefore, the segmentation procedure can be used to divide the brain's skull. The tumour is present within this Region of Interest (ROI). A segmented mask of skull is produced via a thresholding method based upon OTSU [13]. The fourth phase is feature extraction where the symptom or behaviour of the disease can be illustrated by analysing the computed features. The choice of features has the biggest impact on classification. Border irregularity, asymmetry and diameterare frequent characteristics. The fifth step is classification where the deep learning methodology is helpful as convolutional neural network creates the deep neural network [14].

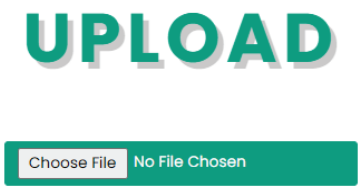

Figure 1: Working application

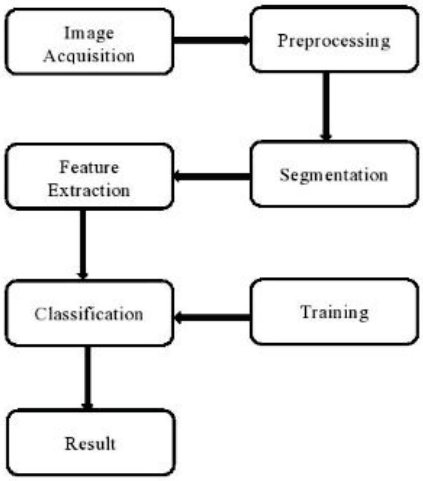

Figure 2: Brain Tumor detection process

IV. IMPLEMENTATION AND TESTING

The act of carrying out, or practicing a plan, a method, or any concept, idea, model, specification, standard, or policy is known as implementation. Therefore, in order for something to actually happen, some action must come after any initial thought. Obtaining brain tumour photos from hospitals and online standards datasets is typically the initial step.

BRAIN TUMOR DATASET

The dataset consists approximately 4358 images of brain MRI samples specimens. Three sets of features are also provided per image: a shape contiguous descriptor, an interior texture histogram, and a fine-scale margin histogram.We have considered the images from the hospitals and from online standarddata set as shown in the figure 3.

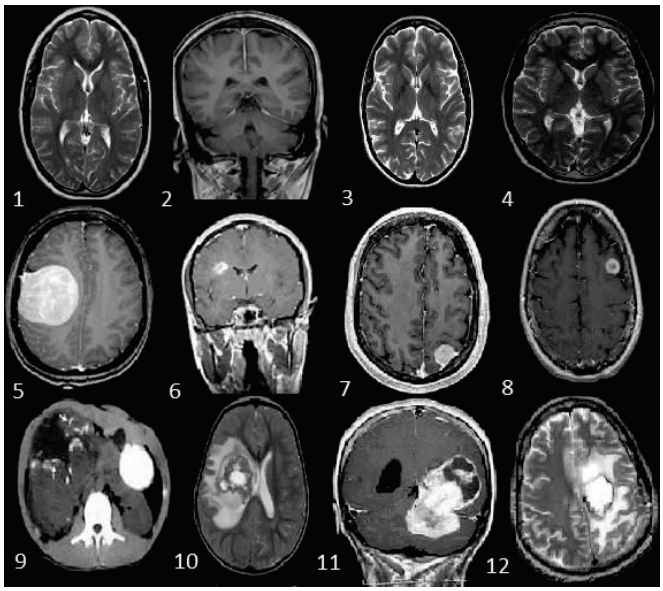

Figure 3:Brain Tumor Dataset

The suggested method was tested on large number of images with the brain affected by tumor and normal brain images. The suggested method is developed using few images and then tested over different variety cases and individual images. The method is made to function on a stack of photos and deliver cumulative results, or it can produce results on a single image. The accuracy of the method was tested on cases provided by Datasets which are already stored for the affected and uninfected cases. to cross-validate the method as illustrated in Figure 4 shows the code snippet of testing. Figure 5 shows the code snippet of training.

```
number = random.randint(0, 59)
image = cv2.imread(os.path.join('pred', f'pred{number}.jpg'))
image = Image.fromarray(image)
image = image.resize((IMG_SIZE, IMG_SIZE))
image = np.array(image)
image = np.expand_dims(image, axis=0)
```

Figure 4: Test code

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```
import numpy as np
from PIL import Image
from sklearn.model_selection import train_test_split
from keras.utils import normalize
from keras.models import Sequential
import keras.layers as layers
import matplotlib.pyplot as plt

IMG_SIZE = 64

with ZipFile('data.zip', 'r') as f:
    f.extractall()

image_directory = 'datasets'
no_tumor_images = os.listdir(os.path.join(image_directory, 'no'))
yes_tumor_images = os.listdir(os.path.join(image_directory, 'yes'))

no_tumor_dir = os.path.join(image_directory, 'no')
yes_tumor_dir = os.path.join(image_directory, 'yes')
```

Figure 5: Train Code

V. RESULTS AND ANALYSIS

In this section we will see the results and analysis of proposed work. Here theMRI images of brain are given as input and then algorithm detects if the tumor is present or not. If there is a presence of tumor it will output Yes Brain Tumor, else it will output No Brain Tumor.

Figure 6: Testing Result

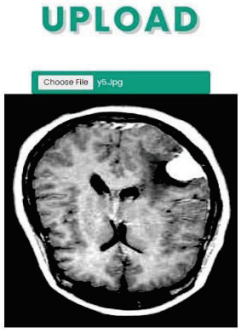

Figure 7: Testing Result

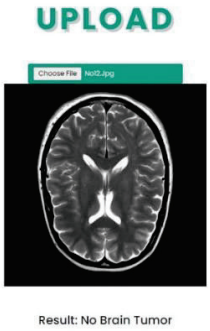

Figure 8: Testing Result

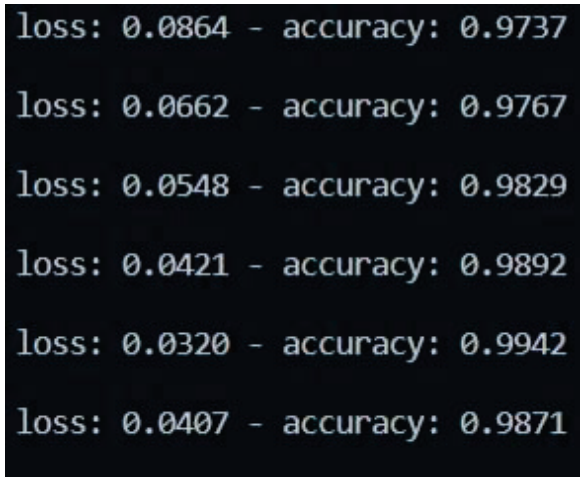

Figure 9: Accuracy Graph

VII. CONCLUSION AND FUTURE SCOPE

The Project focuses on developing analgorithm using image processing for the recognition of the presence of brain tumor. One of the vital Application of image processing is to identify the issues or ambiguity in the images. This algorithm helps us to find the presence of tumor in the effective way and with high accuracy.

This algorithm outputs the classification as yes or no, if there is a presence of tumor it will outputs yes brain tumor, else it will outputs no brain tumor.Here the classification is displayed to the user by using Flask framework where the classification can be hosted on the server and where the user can upload the images and get the output. As the further development we will try to classify the stages of tumors based on the size of tumor and the properties or symptoms.

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