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DETECTION OF ALZHEIMER'S DISEASE USING CNN

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Abstract : Treatment is complicated by the laborious and prone to error nature of modern MRI analysis for brain tumour detection. Using several MRI datasets, we suggest a technique that combines deep learning, conventional classifiers, and CNNs. Algorithms for activation and SVM validation are used. Our CNN surpassed prior records with an accuracy of 99.74% when it was implemented in Python using TensorFlow and Keras. With this automated method, brain tumour diagnosis should be greatly improved, allowing patients' treatment choices to be made more quickly.

Keywords: Alzheimer's, CNN, Keras, TensorFlow, Max Pooling, Batch Normalization.

I. INTRODUCTION

When we talk about non-invasive ways for peering inside the body, we're talking about medical imaging. Diagnostic and therapeutic goals are the primary uses of medical imaging in the human body. In light of this, it is important for both human health and improved treatment. The success of image processing at a higher level is contingent upon the critical and fundamental stage of image segmentation. In this instance, the segmentation of the brain tumor from the MRI pictures has been our primary concern. It facilitates the medical representatives' ability to locate the tumor in the brain with ease. In order to diagnose diseases, direct medical interventions like surgical planning, or conduct research, medical image processing involves the use and exploration of 3D image datasets of the actual body, typically obtained from computed tomography (CT) or magnetic resonance imaging (MRI) scanners. Clinics, engineers, and radiologists use medical image processing because they have a thorough understanding of the anatomy of each patient or population group. Quantification, statistical evaluation, and formulation. For example, by including genuine anatomical geometries into simulation models, the interaction between human anatomy and medical devices can be better understood. There are three basic types of tumours: 1) Benign; 2) Pre-Malignant; 3) Malignant (cancer can only be malignant)

Benign tumour - A benign tumor isn't invariably cancerous or malignant. In contrast to cancer, it might not spread to other parts of the body or infiltrate nearby tissue. The prognosis for benign tumours is usually quite good, but things can get dangerous if they spread to important organs like blood vessels or nerves.

Pre-Malignant tumour - The cells are not malignant in the specified numbers. But they must have the capacity to develop into cancer. The cells will proliferate and unfold into other bodily parts.

Malignant tumour - Malignancy is defined as "bad" (ignis = "fire") Tumours classified as malignant are cancerous. Once cells begin to multiply uncontrollably, they develop. The disease will become dangerous if the cells continue to expand and unfurl. Malignant tumours spread swiftly and use a process called metastasis to spread to other parts of the body.

II. LITERATURE SURVEY

[1] A deep learning based convolutional neural network model with VGG16 feature extractor for the detection of Alzheimer Disease using MRI scans
Authors: Shagun sharma & Kalpana Gularia
Year: 2022
For improved management, early diagnosis of Alzheimer's disease (AD) is essential, although it might be difficult due to the limited diagnostic tools available. Early identification is promising when utilizing deep learning (DL), especially with MRI images. High accuracy, precision, recall, AUC, and F1-score are attained in this work using a DL algorithm with a VGG16 feature extractor on two MRI datasets. As compared to earlier versions, the results show superior performance.

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Several ML and DL methods for AD stage detection are also listed in the publication. With an accuracy rate of 90.4% for dataset 1 and 71.1% for dataset 2, this method has the potential to enhance early AD diagnosis and treatment plans.
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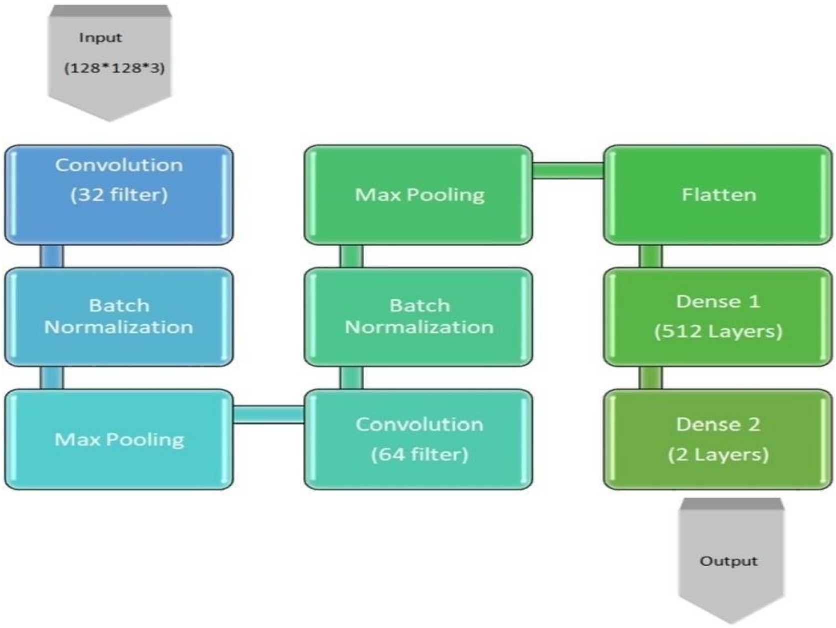
[2] Alzheimer Detection Using Convolutional Neural Network.
Author: Y. Drakshayani1 and Dr. G. Sreenivasulu
Year: 2023
Alzheimer's is a serious neurological condition that has to be diagnosed as soon as possible to stop additional brain damage. Manual analysis techniques are laborious and prone to mistakes. In order to achieve accurate and effective diagnosis, this essay suggests using Convolutional Neural Networks (CNNs) to assist with MRI image analysis. Using MRI images, CNNs trained on pre-existing models divide Alzheimer's into mild, moderate, and non-Alzheimer's phases, automating and expediting diagnosis while lowering errors. The goal of the project is to use deep learning to diagnose Alzheimer's disease early and reliably, enabling prompt treatment. With its ability to accurately diagnose Alzheimer's across all phases, the CNN model is a huge technological achievement in medicine and holds promise for future advancements in the fight against this debilitating condition..

[3] Deep Learning Based Binary Classification for Alzheimer’s disease Detection using Brain MRI Images
Authors: Emtiaz Hussain; Mahmudul Hasan, Syed Zafrul Hassan and Tanzina Hassan Azmi
Year: 2020
Alzheimer's disease is a chronic, irreversible brain disease that progressively impairs thinking and memory abilities as well as the capacity to perform even the most basic tasks. It is now regarded as one of the major illnesses globally. Furthermore, there isn't a treatment for Alzheimer's. Alzheimer's disease identification is made easier with the application of machine learning techniques, particularly the deep learning-based Convolutional Neural Network (CNN). CNN has made significant progress in scientific research and MRI image analysis recently. Numerous studies have been conducted to identify Alzheimer's disease utilizing CNN-enabled brain MRI images.

III. METHODOLOGY



When processing medical images, convolutional neural networks are a methodical technique. One type of artificial neural network designed primarily for technique component knowledge in image recognition and processing is the convolutional neural network (CNN). CNN is a powerful computational method for processing images and images that use deep learning to do tasks that are both descriptive and generative. Machine vision is typically used; encompassing renderer systems, language communication procedures, and image and video recognition (NLP).A computer code and hardware system that performs operations akin to those of neurons in the human brain may be called a neural network. Artificial neural networks are not the ideal choice for image processing. A CNN uses a system that was designed with fewer process needs and looks like a multilayer view point. The approach is much more efficient and makes it easier to train data for both language and image processing when limitations are removed and processing capability for pictures is increased.

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After modifying the original CNN model, we have projected an improved version of it. We have the best comprehension of the tumour because to our 9-layer CNN model, which has 14 phases and hidden layers. In Fig. 3.1, the suggested methodology is shown with a brief description.

We converted each image to a set size of 128*128*3 to give them their varied dimensions, and then we used a wide range of photos as input for our proposed technique. We usually build a complicated convolutional kernel that applies 32 size 2*2 convolutional filters with the help of three channel tensors. We often use ReLU because of the activation function. The corrected linear activation function, or ReLU, will output the input directly if the input is positive; otherwise, it will output zero. Next, we put the 2015 batch normalization suggestion into practice. Batch normalization, which is often referred to as the batch norm, is a technique that can provide neural networks more stability and speed by normalizing the layer inputs through rescaling and recentering. It served as our algorithm's speed bump.

The next step in the pooling operation is to swipe a 2D filter over each channel of the feature map, and then add up the features that lie inside the coverage zone of the filter. The dimensions of output obtained after a pooling layer for a feature map with dimensions nh*nw*ncis

$(nh-f+1)/s * (nw-f+1)/s * nc$
Where ->nh-height of feature map
->nw-width of feature map
->nc-no. of channels in the feature map
->f-size of filter
->s-stride length

A normal CNN model architecture is to have many convolutional and pooling layers piled up one after the other.

Pooling layers are used to reduce the size of the feature maps. Because of this, figuring out how much processing is done within the network takes fewer factors. The pooling layer provides an overview of the properties in a range of the feature map generated by a convolutional layer.

Therefore, additional operations are performed to summarize features instead of utilizing the convolutional layer's precisely positioned features. The model can now discriminate between various feature locations in the input image more effectively.

IV. PROPOSED SYSTEM

Using a 2*2 Maxpooling operation, the highest element from the feature map range that the filter covers is selected in this instance. Consequently, the output after the max-pooling layer would be a feature map that included the most important features from the prior feature map.

After this stage, we used batch normalization, maxpooling, and 64-filter convolutional methods again before flattening. Two thick layers were proposed, with the last two levels located in the second dense layer and the first dense layer containing 512 hidden layers. We choose softmax as the last layer's activation function since it offers more accuracy than the other activation functions. Again, RMS (Root Mean Squared Propagation) was utilized as the loss function along with RMS (categorical cross-entropy). RMS is an expansion of adaptive and gradient descent.
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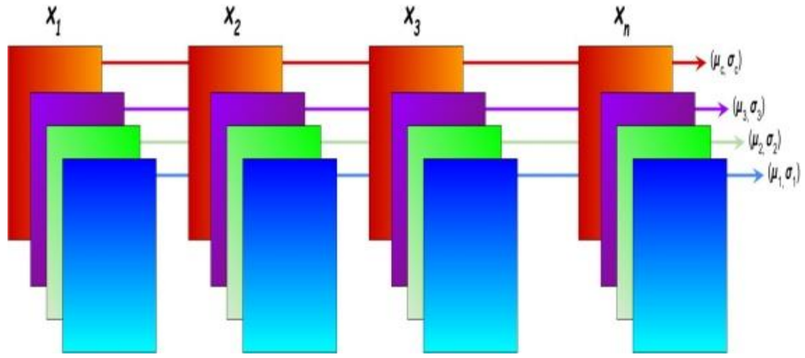

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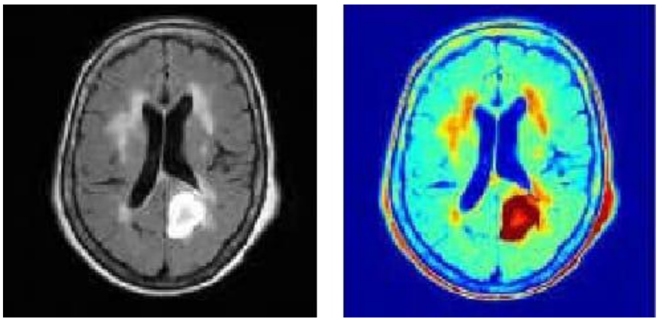
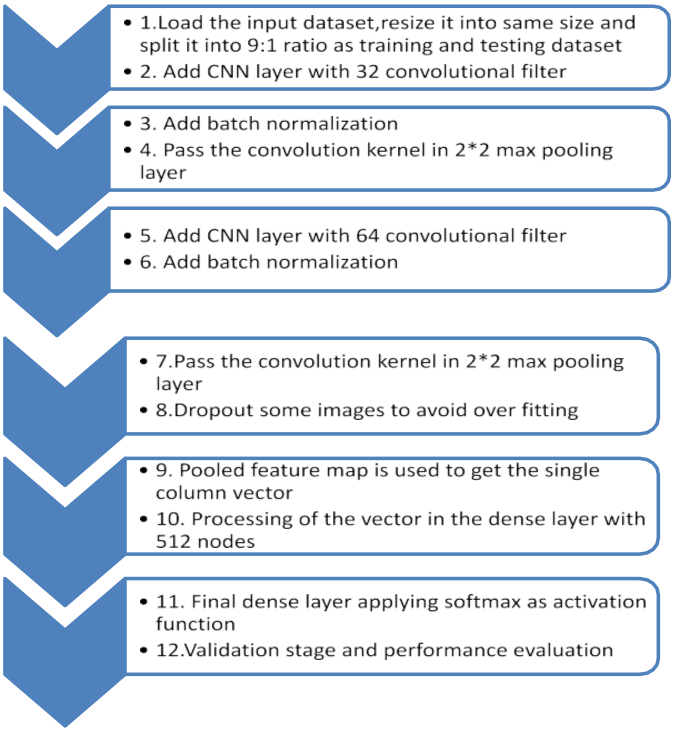
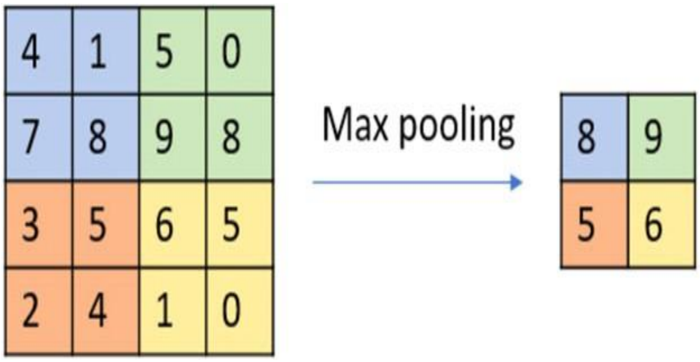
Batch Normalization



Grey Scale Image



Flow chart of Working CNN Model



2x2 Max Pooling

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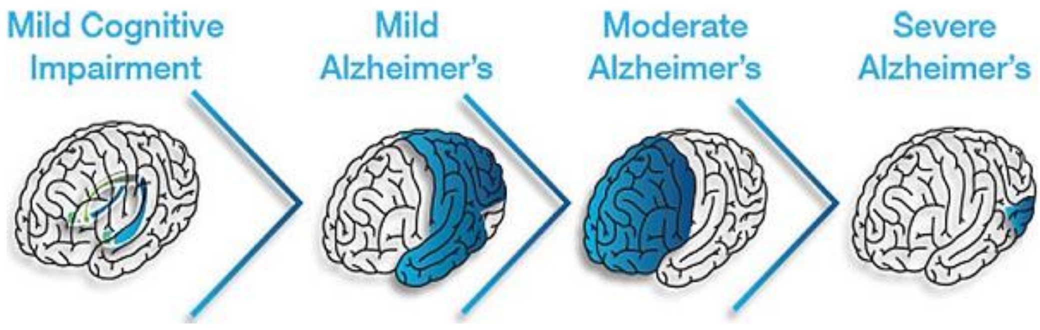


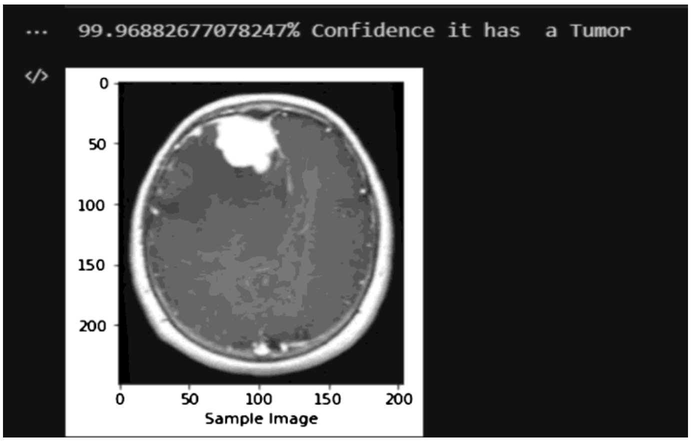
1% to 30% 31% to 60% 61% to 85% 86% to 100%

Stages of Alzheimer's disease

Requirements:

- Kaggle Platform: One of its main features is its competitions, where data scientists and machine learning specialists compete to create the best predictive models for certain tasks. These competitions usually provide cash prizes that range from few thousand to hundreds of thousands of dollars, based on the complexity and sponsor.
- Python: Poised for its ease of learning and comprehension, Python is a popular high-level interpreted programming language. The creator, Guido van Rossum, released the first edition of it in 1991. Numerous fields, including scientific computing, web development, data analysis, and artificial intelligence, heavily rely on Python.
- CNN stands for Convolutional Neural Network. This is the CNN Algorithm. Particularly helpful for interpreting visual images is this type of artificial neural network. CNNs have a wide range of uses, including object identification, image recognition, and picture classification.
- Magnetic resonance imaging (MRI) brain tumour datasets: These are collections of imaging data from brain MRI images used in medicine. These databases frequently contain metadata about the patients, the tumour, and the clinical outcomes in addition to images of patients with and without brain tumours.
- Score code: Source code is the human-readable instructions or statements that a programmer puts in a programming language to create a software program. It is essentially the first version of a computer program that is not yet translated into binary machine code for computer execution. The syntax and rules that must be adhered to while writing source code are specified by the programming language in use.

V. RESULTS



As the result, accuracy is 99.96% and the stage detected as Severe Alzheimer's which is obtained by using more than 600 images and with confidence the detection of Alzheimer's disease is done.

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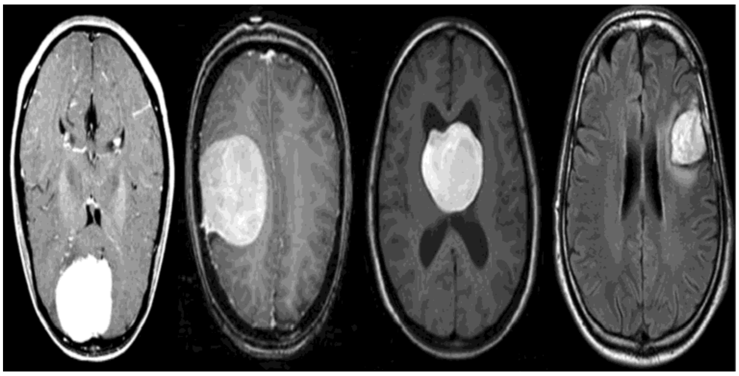

MRI Image with Tumour

VI. CONCLUSION

Classifying and segmenting tumours is the most prevalent use of MRI. Notwithstanding their capacity to automatically acquire representative complex information for both tumorous and healthy brain tissues directly from the multi-modal MRI images, we opted to improve the accuracy of convolutional neural networks (CNNs). An accuracy of only 20.83% was obtained in our first effort to employ SVMon CNN. We next tried several other configurations. To end up with AdaMax, we changed the optimizer and softmax parameters. Then, we were accurate to 98.10%. We ultimately obtained an accuracy of 99.74% in the output, though, after deciding to use an RMS for the optimizer instead. After utilizing 273 numbers of training photographs and 273 images for testing in a 9:1 ratio, we were able to get our ultimate result. An eleven-phase process. We use a 9-layer, 14-stage CNN model in our method. Primarily, we also eliminated a handful of images to prevent overfitting.

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