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Faster R- CNN Using MRI : Cerebrovascular Diseases

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ABSTRACT
Cerebrovascular diseases such as stroke are among the most common causes of death and disability worldwide. Stroke is a severe condition that requires prompt diagnosis and treatment to prevent disastrous consequences. In this piece of work, we present a unique approach to detect brain stroke using Deep Learning techniques. To achieve this goal, we have developed an early stroke detection system based on magnetic resonance imaging (MRI) of the brain couple with a genetic algorithm and a faster R-CNN to detect stroke at a very early stage. Faster R-CNN architecture consists of two components Region Proposal Network (RPN) and Faster R-CNN detector. Cross validation was used to evaluate the accuracy of the diagnostic system.
Keywords — MRI, Faster R-CNN, RPN, SVM.

INTRODUCTION

Cerebrovascular diseases such as stroke are among the most common causes of death and disability worldwide causing over 7.3 million deaths annually. CVA is a medical emergency that arises when there is a disruption in the blood supply to the brain, causing damage to the brain tissue. There are two types of stroke: ischemic stroke and hemorrhage-related stroke. Prompt identification and management of strokes are essential to avoid serious outcomes like irreversible impairment or even demise. Stroke is a severe condition that requires prompt diagnosis and treatment to prevent disastrous consequences. Because they provide precise picture of the brain medical imaging methods for the diagnosis of strokes specifically, magnetic resonance imaging (MRI) and computed tomography (CT) are crucial. In this piece of work, we present a unique approach to detect brain stroke using Deep Learning techniques. We employ a variety of techniques, including support vector machines (SVM), decision tree and decision tree and deep learning models to efficiently identify and categorize stroke cases from medical imaging data. The aim of this study is to identify reliable methods, algorithms and features that help medical professionals make informed decisions about stroke treatment and prevention. To achieve this goal, we have developed an early stroke detection system based on magnetic resonance imaging (MRI) of the brain couple with a genetic algorithm and a fast R-CNN to detect stroke at a very early stage. Cross validation was used to evaluate the accuracy of the diagnostic system. deep learning, convolutional neural networks (CNNs), and region proposal networks (RPNs) into a cohesive network, which significantly improves the speed and accuracy of the model. Previously R- CNN and Fast R-CNN models uses traditional Selective Search algorithm for generating region proposals. It runs on CPU so it takes more time in computations. Faster R-CNN fixes these issues by introducing a convolutional-based network i.e. RPN, which reduces proposal time for each image to 10 ms from 2 seconds and improves feature representation by sharing layers with detection stages.

Region Proposal Network (RPN) is an essential component of Faster R- CNN. It is responsible for generating possible regions of interest (region proposals) in images that may contain objects. It

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uses the concept of attention mechanism in neural networks that instruct the subsequent Fast R-CNN detector where to look for objects in the image. The proposed diagnostic system achieved large data set with an accuracy of 98.5%. we also compared the performance of the proposed model with random forests, Naïve Bayes and SVM.

EASE OF USE

First, Significant number of medical pictures are created in a short of time due to advancement in medical imaging and neuroscience. As a result, a strategy for reducing clinical efforts is necessary. Object detection is a technique is technique for recognizing and locating all known items in a given environment. The data from the object detector may be utilized to navigate around any barriers in the area. Automatic tooth detection, pedestrian walking, industrial inspection, quality inspection, traffic analysis, food product inspection, book identification on the shelf, and medical analysis are just a few examples of where object detection is employed. Because human involvement in any endeavor take time. Because humans are more prone to making mistake, the goal of this study topic is to develop a system that can recognize things more precisely

Methodology

There are various methodologies available for object detection. Some of the techniques are Machine Learning (ML) in which separate rate approaches are required for feature extraction and separate approaches are required for classification, but in deep learning, the same algorithm can be used for feature extraction and classification. And some of The Researches have presented a detailed explanation of some of the deep learning based object detection.

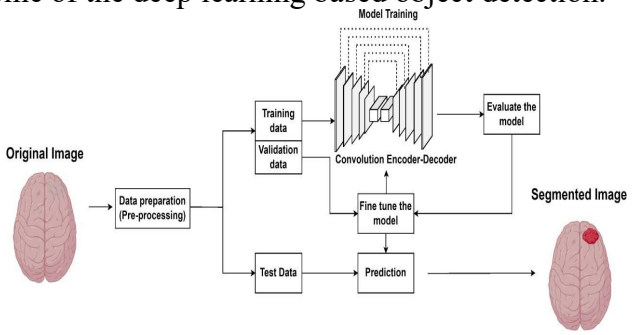

Fig 1: Deep learning neural network

R-CNN(Region – based convolutional Neural Network)

A Network named Region – based Convolutional Neural Network The R-CNN pipeline works in such a way that the input image goes through pre-processing until proposals in different regions are generated. Each proposal is resized and passed through the CNN for feature extraction. These features are then used to deduce the object's presence and class of interest from the Support Vector Machines (SVMs) classifiers. Finally, the bounding box regressor fine-tunes the locations of the objects. Here is the R-CNN architecture delineating how it processes input images for object detection tasks.

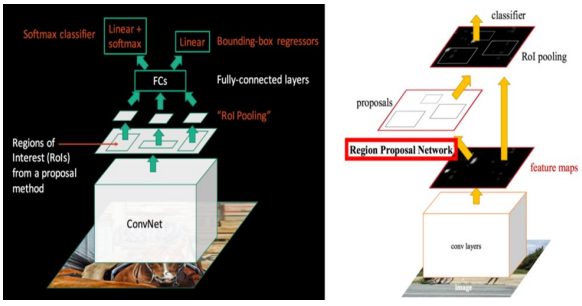

Fig 2: Region Proposal Network

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Faster R-CNN depend on three stages:

a. Region proposal
b. Feature extraction
c. Classification

a. Region Proposal:

In Faster R-CNN, a selective – search method is used for region proposal. In this approach, initially the input – image is divided into many regions. Then based on the similarity between CNN regions, the regions are merged. It means it creates a cluster of similar regions. This process is repeated until the object is located. Finally, it established the bounding box on the locate image.

b. Feature extraction:

The cropped portion of the identified region is taken as input to the feature extraction. Then the cropped image is resized to pass through CNN to extract useful features. Here the object is divided into two classes background class and foreground class.

c. Classification:

Here, the input to the classification is feature representation. Then SVM is used for classification purposes, which is used to predict the label of the object is located. The License plate detection system is proposed using R-CNN. The proposed license plate detection improves the detection accuracy by semantics of region proposal techniques

MODULE

A. System Module

1) Train data set

System can give training to the data set.

2) Pre – processing

Pre-processing will be done using PCA module

3) Model Performance

In this step the machine mainly concentrates on the accuracy precision and recall. Without have the highest rate of accuracy, the development of system is useless. So, it is better to have accuracy system. Accuracy can be calculated by the taking the number of correct predictions from the total number of predictions.

4) Predictions

Using the deep learning algorithms, we can predict the result.

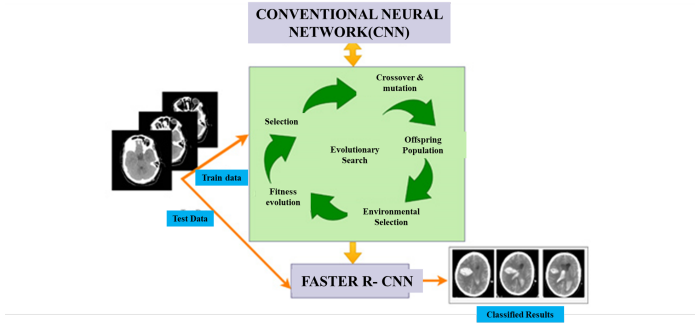

Fig 3: Classification

B. User Module

1) Upload dataset

The user uploads the dataset

2) View dataset

The uploaded dataset is viewed by the user.

3) viewing graphs

Graphs can be generated by the system and the user can be view that graphs.

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ALOGRITHMS

INPUT: Noisy input image
OUTPUT: Enhanced image using 3 * 3 window
Steps

1. A 3 * 3 window is slide over the entire image
2. Sort the pixels, denoted by Aij inside the window in ascending order
3. Find the minimum, maximum and median of the pixel values, denoted as Amin Amax and Amed
4. If(Amin < Amax < Amed)
5. Mark the central pixels as uncorrupted(No filtering required)
6. Else
7. If (Amed is not an impulse(Boundary value))
8. Replace a central with Amed

Else

9. Replace a central with Ai-1,j

End if
End if

10. Repeat step 2 to 9 for entire image

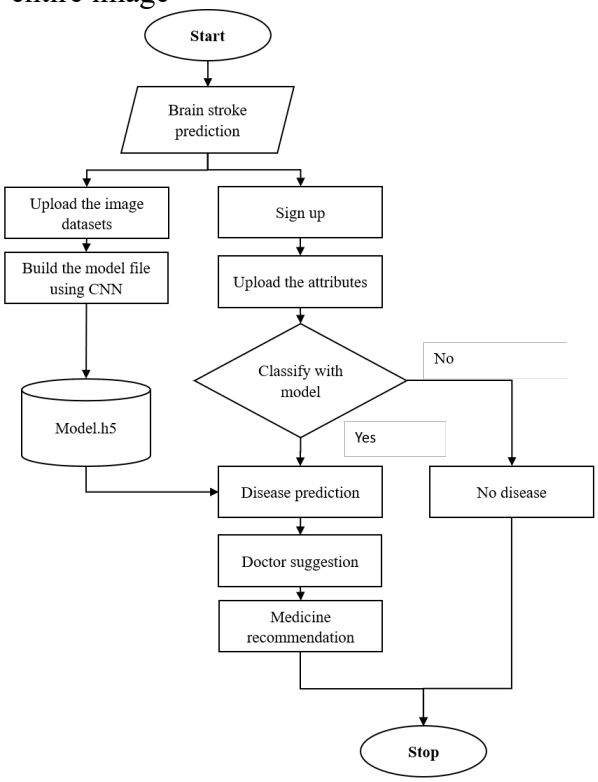

Fig 4: Flowchart

Experimental Result and Analysis

Based on the collected data, automatic lesion detection is implemented using three categories of object detection networks.

Parameters	Faster R-CNN(VGG-16)	Faster R-CNN(ResNet-101)
Initial learning rate	0.001	0.001
Learning rate strategy	Step	Step
Batch size	16	16
Optimizer	Adam	Adam

Table 1: Comparison of Faster R-CNN and Faster R-CNN

FPN depends on cross-scale connections and weighted feature fusion.

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Cross-scale connections: Those nodes are removed with one input edge and no feature fusion. An extra edge is added from original input to an output node to fuse more features. The same layer is repeated multiple times to enable more high level feature fusion.
Weighted feature fusion: Multiple input features are first resized to the same resolution and then sum them up as different input feature are at different resolutions, so they contribute to output feature unequally. For each input, additional weight is added so that network can learn the importance of each input feature

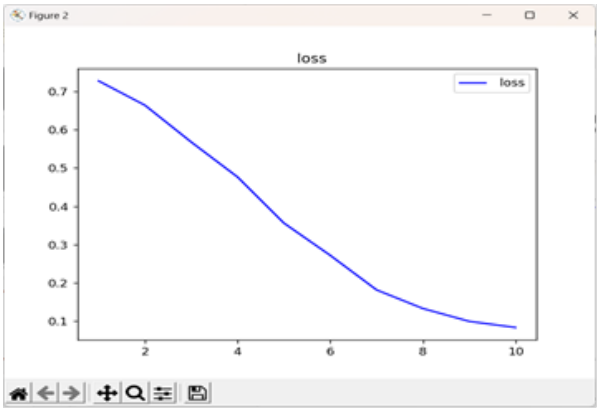

Fig 5: Training Accuracy

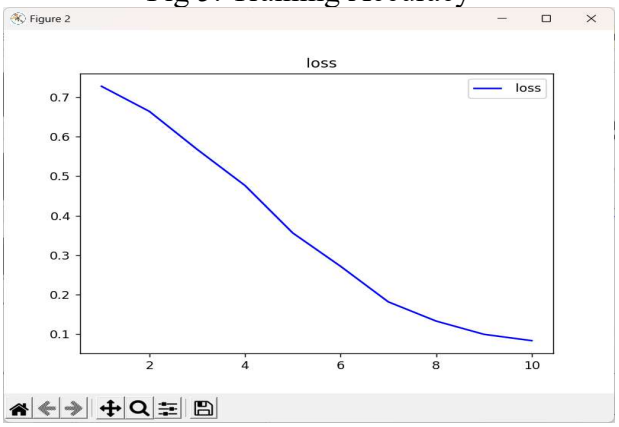

Fig 6: Training Loss

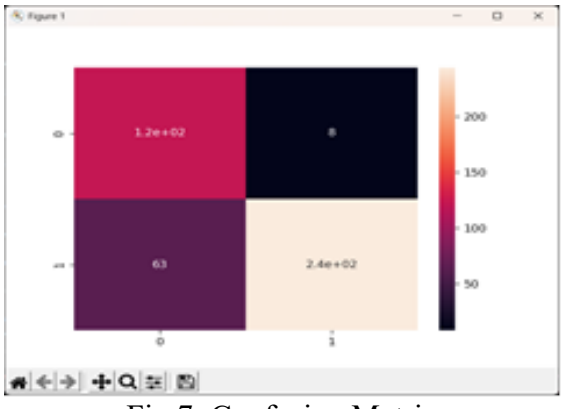

Fig 7: Confusion Matrix

CONCLUSION

This study proposes a method for stroke detection using machine learning techniques. An image-based dataset is used to validate the performance of the newly developed model. This proposed model is based on a genetic algorithm and faster R-CNN. A genetic algorithm based on a neural network is applied to recognize the key features of MRI brain images. These features are input into

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the BiLSTM and R-CNN models for stroke prediction. The performance of different k-folds was evaluated to determine which is most effective classification. We also tested different deep learning algorithms for stroke prediction. The results of the experiment show that the proposed deep learning model is more efficient than other models. To improve stroke detection in the future, we aim to use more complex models that can predict strokes automatically. This study used deep learning models on a modest dataset, with large datasets generally performing better. Addition to data quality plays an important role in the performance of deep learning models. So we need to develop new methods that will help improve the data quality in the future. In the future we will develop these explainable AI methods to help healthcare professionals make more informed decisions based on these AI results.

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