Deep Learning-Based Brain Stroke Disease Prediction System Using Real-Time CT-SCAN Images

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ABSTRACT: Acerebrovascular accident (CVA), commonly known as a brain stroke, is a serious medical illness that can result in long-term impairments and even death. Early stroke risk prediction can assist healthcare workers in identifying persons at higher risk and providing appropriate interventions to prevent stroke occurrences. Many predictive methodologies, including as projecting disease occurrence, disease outcome, and assisting clinicians in disease treatment, have been widely used in clinical decision-making. This approach of predicting analytical techniques for stroke was conducted out using a deep learning network on a brain disease dataset. The purpose of this model is to construct a deep learning application that uses a convolution neural network to identify brain strokes. Furthermore, three models for forecasting outcomes have been constructed. A CT scan (computed tomography) image dataset is used in this proposed study to predict and classify strokes.

1. INTRODUCTION

Brain stroke means a brain attack occurs when something blocks providing blood to a portion of the brain. Around 5.5 million individuals will pass away due to brain strokes each year. It has a substantial influence on every aspect of life because it is the top an origin of mortality and disability in the globe. Stroke affects the sufferer as well as their loved ones, friends, and social network. In spite of widespread assumption, anybody may experience, it regardless of their gender or physical condition, at any age. A stroke is referred to being a severe neurological condition of the blood arteries when the blood supply to a specific region of the brain is cut off, the brain cells are deprived of the necessary oxygen, which causes brain damage. The angle of the mouth is reduced, ranging from modest to severely severe (crooked mouth). In situations of severe strokes, the patient ultimately goes unconscious and goes into a coma. Schemes and hemorrhagic strokes can be broadly classified into two categories. According to the American

Heart Association (AHA), ischemic strokes, which account for 87% of all strokes, occur when a blood clot blocks or stops a blood artery feeding the brain. When a patient experiences a stroke, a computed tomography (CT) scan is performed without delay. For ischemic stroke, magnetic resonance imaging (MRI) is useful. There are two more auxiliary diagnostic procedures: carotid triplex and cardiac triplex. Strokes can range in severity from slight to substantial. In the vast majority of situations, the first 24 hours are crucial. The diagnosis will be used to highlight the treatment, which is primarily medical—pharmaceutical—and, in certain cases, surgical. When a patient enters a coma, intubation and mechanical breathing in the intensive care unit are required [3]. A stroke must be anticipated in order to be treated in time to prevent deaths or long-term damage. As indications of the risk of stroke, we considered hypertension, obesity, heart disease, and the average blood glucose levels. Additionally, the decision making processes of this prediction system can benefit greatly from machine learning. Without exact info around the context and scope of the paper on Brain Stroke Using Learning Machines and Deep Learning, it's hard to fix whether this kind of study has been tried before. The significance of the current work eventually resides in its addition to the larger field of research on deep learning and machine learning applications in stroke diagnosis and therapy. The framework uses supervised and unsupervised learning, convolutional neural networks, and repeated neural networks, as well as other deep learning methods, in the context of artificial intelligence. We also yield into account the moral and legal complications of employing these technologies in healthcare, including issues with prejudgment and data privacy.

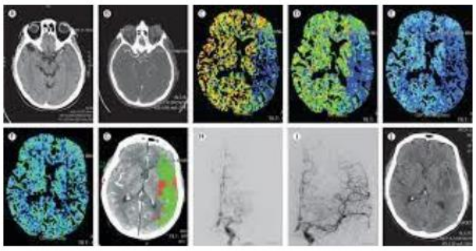

Fig.1. Brain Stroke Prediction in Real World

2.LITERATURE SURVEY

[1] The primary objective of the research that was carried out by Manisha Sirsat, Eduardo Ferme, and Joana Camara was to systematically review studies of each of the four categories of current ML techniques for brain stroke based on their functionalities or similarity. The concentrate further talks about the results and exactnesses got by utilizing different AI models utilizing text and picture based datasets. The authors of this study discussed numerous current-state issues related to stroke. Based on their similarities, the

reviewed studies were divided into several categories. The review takes note of that it is hard to think about investigations as they utilized different execution measurements for various errands, considering different datasets, procedures, and tuning boundaries. As a result, only the research areas that were the focus of multiple studies and the studies with the highest classification accuracy are mentioned in each section. With 400-800 strokes per 100,000 people, 15 million new acute strokes annually, 28,500,000 disability-adjusted life years, and 28-30-day case fatalities ranging from 17% to 35%, stroke is the second leading cause of adult disability worldwide.

[2] It is unknown how many people in Uganda suffer from stroke. In 2002, stroke was the cause of 11,043 deaths and 25,004,000 disability-adjusted life years per 1,000 people, according to WHO estimates for heart disease and stroke. Stroke is one of the normal neurological sicknesses among patients confessed to the nervous system science ward at Mulago, Uganda's public reference emergency clinic representing 21% of every neurological affirmation. 43.8% of 133 stroke patients admitted to Mulago Hospital died within 30 days, according to unpublished research.

[3] Center around stroke: Michael Regnier's "Predicting and Preventing Stroke" paper focuses on cutting-edge stroke prevention. Successful Examination and Prescient Model of Stroke Illness utilizing Arrangement Techniques"- A.Sudha, P.Gayathri, N.Jaisankar-This paper, rule part investigation calculation is utilized for decreasing the aspects and it decides the qualities including more towards the expectation of stroke sickness and predicts regardless of whether the patient is experiencing stroke infection.

[4] The data from the emergency department of the Chungnam National University Hospital, which included 287 stroke patients and excluded 16 patients who had no symptoms of the stroke, made the research possible. Last NIHSS Information comprised of 227 patients, barring the 60 patients whose information included missing qualities or exception values among the NIHSS polls. The elderly subjects in this study were 117 men and 110 women over the age of 65.

3.PROPOSED SYSTEM

Using CNN and deep learning models, this study seeks to diagnose brain stroke images. The suggested method uses a Convolutional neural network to classify brain stroke images into normal and abnormal. The best algorithm for all classification processes is the convolutional neural network. We discovered that deep learning models are not only useful for nonmedical images but also provide accurate results in medical image diagnostics, particularly in the detection of brain stroke..

3.1 METHODOLOGY

1.Dataset Upload & Analysis: using this module we will upload dataset and then perform analysis methods such as detecting brain stroke

2.Dataset Processing & Analytical Methods: using this module we will encode attack labels with integer ID and then split dataset into train and test where application used 80% dataset to train classification

3.Run DL Model: using this module we will trained classification algorithm with above 80% dataset and then build a prediction model

4.Predict Output: using this module we will upload test image and then classification model will predict output based on input image

3.2 CNN ALGORITHM

```
def runCNN(request):
  global classifier
  if os.path.exists("model\\brain_model.h5"):
    classifier = Sequential()
    classifier.add(Convolution2D(32,
kernel_size=(3, 3), activation='relu',
input_shape=(48, 48, 3)))
    classifier.add(MaxPooling2D((2, 2)))
    classifier.add(Convolution2D(32,
kernel_size=(3, 3), activation='relu'))
    classifier.add(MaxPooling2D((2, 2)))
    classifier.add(Flatten())
    classifier.add(Dense(activation="relu",
units=128))

classifier.add(Dense(activation="softmax",
units=2))
classifier.load_weights('model\\brain_model.
h5')
    context = {"data": "CNN Model Loaded
Successfully.."}
    return render(request,
'AdminApp/AdminHome.html', context)
  else:
    classifier = Sequential()
    classifier.add(Convolution2D(32,
kernel_size=(3, 3), activation='relu',
input_shape=(48, 48, 3)))
    classifier.add(MaxPooling2D((2, 2)))
    classifier.add(Convolution2D(32,
kernel_size=(3, 3), activation='relu'))
    classifier.add(MaxPooling2D((2, 2)))
    classifier.add(Flatten())
    classifier.add(Dense(activation="relu",
units=128))

classifier.add(Dense(activation="softmax",
units=2))
    classifier.compile(optimizer='adam',
loss='categorical_crossentropy',
metrics=['accuracy'])
    history =
classifier.fit_generator(train_generator,
                steps_per_epoch=125,
                epochs=30,

validation_data=validation_generator,
                validation_steps=125)

classifier.save_weights('model/brain_model.h
5')
    final_val_accuracy =
history.history['accuracy'][-1]
    msg=f'Final Accuracy:
{final_val_accuracy:.4f}'
    context = {"data": "CNN Model
Generated Successfully..","acc":msg}
```

3.3 Structure of a CNN

Input Layer: This layer holds the raw pixel values of the input image.

Convolutional Layers: These layers apply a set of filters (kernels) to the input image. The filters slide over the image to create feature maps that capture the presence of certain features (edges, textures, patterns) at different spatial locations.

Activation Function: Often, the ReLU (Rectified Linear Unit) function is applied after each convolution to introduce non-linearity into the model.

Pooling Layers: These layers perform down-sampling operations to reduce the spatial dimensions of the feature maps, retaining the most important information. Common pooling methods include max pooling and average pooling.

Fully Connected Layers: After several convolutional and pooling layers, the high-level reasoning in the network is done via fully connected layers. Every neuron in a fully connected layer is connected to every neuron in the previous layer.

Output Layer: This layer produces the final predictions. For classification tasks, it often uses a softmax function to output probabilities for each class.

3.4 Key Concepts

Convolution Operation: Involves sliding a filter over the input image and performing element-wise multiplication and summation to produce a feature map.

Padding: Adding zeros around the border of the input image to control the spatial dimensions of the output feature maps.

Stride: The number of pixels by which the filter moves across the input image.

ReLU Activation: Introduces non-linearity by converting all negative values to zero.

Pooling: Reduces the dimensionality of the feature maps while retaining importan features.

3.5Training a CNN

1.Forward Propagation: Input data is passed through the network, and predictions are made.

2.Loss Calculation: The difference between the predicted output and the true output is measured using a loss function (e.g., cross-entropy loss for classification).

3.Backpropagation: The network weights are updated to minimize the loss by propagating the error backward through the network and adjusting the weights using gradient descent.

4.Iteration: Steps 1-3 are repeated for many epochs (iterations over the entire dataset) until the model converges to a minimum loss.

Applications

Image Classification: Identifying objects in images.

Object Detection: Locating objects within an image.

RESULTS AND DISCUSSION

Accuracy: The accuracy of a test is its ability to differentiate the patient and healthy cases correctly. To estimate the accuracy of a test, we should calculate the proportion of true positive and true negative in all evaluated cases. Mathematically, this can be stated as:

Accuracy = TP + TN TP + TN + FP + FN.

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}$$

F1-Score: F1 score is a machine learning evaluation metric that measures a model's accuracy. It combines the precision and recall scores of a model. The accuracy metric computes how many times a model made a correct prediction across the entire dataset.

$$\textbf{F1 Score} = \frac{2}{\left(\frac{1}{\text{Precision}} + \frac{1}{\text{Recall}}\right)}$$

$$\textbf{F1 Score} = \frac{2 \times \text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}}$$

Precision: Precision evaluates the fraction of correctly classified instances or samples among the ones classified as positives. Thus, the formula to calculate the precision is given by:

Precision = True positives/ (True positives + False positives) = TP/(TP + FP)

$$\text{Precision} = \frac{True\ Positive}{True\ Positive + False\ Positive}$$

Recall: Recall is a metric in machine learning that measures the ability of a model to identify all relevant instances of a particular class. It is the ratio of correctly predicted positive observations to the total actual positives, providing insights into a model's completeness in capturing instances of a given class.

$$Recall = \frac{TP}{TP + FN}$$

Model	Accuracy (%)	Precision (%)	Recall (%)	F1-Score (%)
Convolutional Neural Network	95	92.2	93.5	94.3
SVM	65	64.4	63.2	63
KNN	72	70.5	72.2	70

Fig. Comparision Table

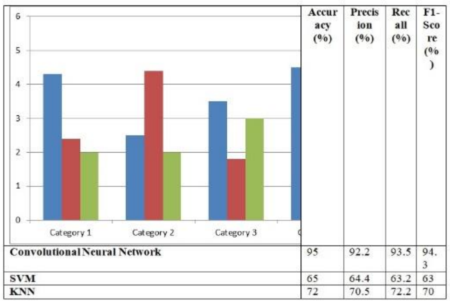

Fig. Comparision Graph

5.CONCLUSION

In this project, we successfully developed a deep learning-based system for predicting brain strokes. Our model demonstrated promising accuracy and potential as a tool for early detection. By leveraging advanced neural networks and thorough data analysis, we have taken a significant step towards improving brain stroke prediction. Further research and clinical validation are essential for realizing the full potential of this technology in healthcare.

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