Deep Learning-Based Quantitative Assessment of Multimodal Features using Lenet Model

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Abstract – Deep learning is used by many applications that are currently the latest technology in evert aspect. Ischemic sensation is a prompt emergency that has necessities to diagnose and treatment it by various deep learning models. For properly detect the stoke must be identifies their feasibility and their risk assessment to make it more early and efficient treatment. Essentially it develops automated methods for identifying and segmented stroke lesions. The MRI images give the good outcomes for early prediction of disease though the various machine learning and deep learning techniques. With the help of MRI images, it provides no ionizing radiation that is used in the imaging method. It develops automated methods which develop and identify the segmented stroke lesions. The various deep learning methods such as the accuracy as in terms of outcome obtained for the brain stroke prediction in the field of IOT and deep learning that improved the performance. In this research the image datasets samples are used to test model by the feature engineering model has been proposed to deploy the MRI images using preprocessing algorithm. The various machine learning algorithms such Dense121, ResNet121, Exception, VGG-16, LeNet etc. These features are trained and validated by pre-trained convolutional neural networks (CNN). The best classification result has been selected by deploying IMV. The proposed work achieved and computed accuracy as in terms such as for Le_Net is 99.4 which is deep learning model.

Keywords – Brain Stroke, Deep Learning, Healthcare, MRI, Stoke Prediction.

I. INTRODUCTION

According to the most recent stroke data, the annual stroke risk worldwide is increasing annually. It has been discovered by researchers that an astounding 10.3 million more strokes happen globally. Strokes rank among the top three causes of death from a variety of chronic illnesses as of 2015. Quick diagnosis can help improve blood flow in the area where ischemia is less likely to occur. To lower the mortality risk, stroke lesions must be correctly and quickly characterized in terms of size and location. Historically, the primary method for lesion segmentation has been manual. This led to the issue of standard computerized segmentation being inefficient for the detection of stroke lesions. Nevertheless, the current Segmentation by hand must be modified. Cross reliability is a statistic that illustrates how different evaluators' conclusions can be consistent with one another. It measures how consistently different doctors for patients judge the same behavior. The lesions are difficult to find and divided into sections. Manually marking an MRI image of a single severe lesion with a convoluted shape may take many hours [1]. To treat more patients in less time, a faster, more precise, and automatic characteristics extraction and disease detection system is necessary. Through deep learning, a computer system could be trained to do categorization tasks directly from photos, text, or voice. In some situations, deep learning systems may be able to achieve accuracy levels that exceed those of humans. In order to train models, layered A large number of data sets and neural network components are used. Using a technology called deep learning, an automated intelligent system can mimic human learning. Predictive modelling and statistics are part of data science, which also includes deep learning. Data researchers, who are in charge of gathering, evaluating, and interpreting vast amounts of data, will find it to be of great use. Deep Learning expedites and simplifies the process [2]. It is a prominent area of study with numerous applications. Convolutional neural networks, or CNNs, are employed in the classification of images. At its most basic, deep learning may be thought of as a way to automate data analytics. Deep learning algorithms, in contrast to conventional machine learning algorithms, are developed in a hierarchy of progressively greater difficulty. Once a neural network, or CNN, is used to classify images. At its most basic, deep learning may be thought of as a way to automate data analytics. Deep learning algorithms, in contrast to conventional machine learning algorithms, are developed in a hierarchy of progressively greater difficulty. Each algorithm in the hierarchy applies a nonlinear modification to the output once it is sufficiently exact, and then uses learning to build a statistical model [3]. Conversely, CNN-based algorithms have the drawback of needing more training data. Acquiring medical photos and precisely annotating data are expensive and challenging jobs when working on medical image processing tasks. CNN's innovative architecture is the U-net. Based, has solved this issue by using skip connections between the mirror levels inside the encoder and decoder in addition to a symmetric coder and decode structure.

The neurological condition known as a stroke is brought on by a blockage or constriction of a blood vessel [4]. A stroke may cause a blood clot in the brain, depriving brain cells of oxygen. The brain and other bodily organs may not operate as well as they should if brain cells eventually die. It could make it difficult to move around, speak, or even be fatal. According to data from the World Stroke Organization, 13 million people worldwide suffer from strokes each year, and 5.5 million of them pass away as a result [5]. Given that it is the primary cause of fatalities and disabilities worldwide, a brain stroke has a profound effect on numerous aspects of existence. Stroke patients have to deal with significant social and economic repercussions. The frequency of stroke doubles after age 55 and is influenced by age. However, according to a survey, the percentage of people aged 20 to 54 who had a stroke increased from 12.9% to 18.6% between 1990 and 2016[6-8]. Brain stroke is the second leading cause of death globally, after heart disease. Thus, predicting the occurrence of strokes can help guarantee that patients receive the right care in time to avoid permanent disability and death.

In clinical investigations on brain anatomy, magnetic resonance imaging (MRI) has become an essential tool [9]. Due to its excellent resolution and contrast, magnetic resonance imaging (MRI) is the most commonly used medical imaging method [10]. It is highly precise and capable of responding gradually to changes in tissue firmness needed for pathological consultation. The suggested method makes use of the MRI image dataset. to forecast cerebrovascular accidents. Several non-invasive techniques for predicting brain stroke have been presented by researchers on the Internet of Things (IoT) and healthcare sectors. Machine Learning (ML) models are widely used in the creation of computer-supported systems for brain stroke detection. On the other hand, feature dependence and preset qualities underpin machine learning techniques. In the suggested work, a useful model for the brain Deep learning techniques is being developed for the Internet of Things healthcare sector to predict stroke from MRI scans. As a result, the model gains independence and increases prediction accuracy for brain strokes. The remainder of the paper is as organized as follows: in **section 1** discuss the introduction in which deep learning methods used for brain stroke detection, as in **section 2** discuss about the literature review and in other following **section 3** discuss the results and deep learning techniques and tools used for brain stroke prediction and in **section 4** conclusion and future work are covered.

II. LITERATURE REVIEW

In the field of brain stroke prediction using artificial intelligence has been subject to a contribution by the various authors in the various datasets. Recent contributions that utilize the dataset for various evaluation purposes such as disease etc. Various machine learning models are including such as SVM, Naïve Bayes, Decision tree, Random Forest and logistic regression that are used to predicting the stroke. The research supports various deep learning models for the various stages of stroke recovery.

The author [11] conducted a study on the implementation of various deep learning models which were identifying the disease as many countries. In this study train and test the different models by the weight voting classifier to improve the accuracy and performance for various aspects of study. Model is optimized and results are analyzed by the RF voting classifier and obtain accuracy in terms of performance rate as it 97%. In [12] it has done study on the brain stroke for EEG biometrics signals during physical activity of patient that can detect the stroke. In this paper random forest provides better results to detect the stroke results by the various biometric signals.

The proposed work [13] with the help of different data mining tools or the machine learning algorithms identifying the disease at an early stage of stroke by their symptoms. The author proposed the may implementation methods and tools for getting the beat results as in terms of higher accuracy rate. ANN gives accuracy 95.3% as compared with other models.

Proposed [14] researchers used the various datasets that are collected from various online repositories and operate it on missing values dataset values to handle the imbalanced data handling.in as naïve bayes algorithms achieve accuracy 82% for the some parameters of earlier brain stroke.

In [15]. in this proposed work various type of classifiers is using to predict the brain stroke disease. With the help of different model of machine learning hyperparameter tuning and cross validation performance is computed by their implementation results. The author tried to perceive more accuracy by developing model as for training and testing methods.it achieved 90 % accuracy and among from the various models used. [16] proposed a prediction model for stroke that handles the imbalanced data. this imbalanced data is collected from the online repository by using various smote techniques and machine learning models, using the system model implementation for brain stroke prediction RLR techniques used and achieved accuracy 95%.

The CT [17] scan data of stroke patients from the Hajj Hospital in Surabaya, Indonesia, has been gathered. To enhance the quality of the image, pre-processing involves using image processing techniques such data conversion, cropping, scaling, grayscale and data augmentation. Additionally, feature extraction is used with picture data. The accuracy of eight algorithms, including Random Forest, Decision Tree, Logistic Regression, and Naïve Bayes, are then contrasted. When compared to other classifiers in this experiment, Random Forest achieves the greatest accuracy of 95.97 percent.

In [18] study on stroke, artificial intelligence used to predict strokes based on real-time bio signals. This system uses the Random Forest (Machine learning) and Long Short-Term Memory (Deep learning) algorithms.

III. RESEARCH OBJECTIVE

The proposed research work has the following objective:

1. To study and analyze the deep learning model for brain stroke.
2. To select the different features as per the prediction of various models.
3. Various performance metrics are computed for brain stroke samples and achieved accuracy to compare the existing research.

IOT and Deep Learning Methods & Tools

For brain stroke detection various IOT and deep learning tools used for classifying and analyzing the disease at early stages. CNN stands for Convolutional neural network also called ConvNet[11]. It is a deep learning algorithm which is designed for image identification, recognition, detection, and segmentation. CNN is employed used as variety of scenarios such as vehicles other detection systems [12].

Regularization in over fitting in CNN

Machine learning models used DNN learning projects. The model learns the training and testing data. It reduces the noise and outliers. Learning means a model performs according the dataset that have to be trained and tested as per requirements. As we know the Overfitting is common challenge in the field machine learning [13]. Overfitting occurs when training data is more as such it has noise and some outliers. Deep learning leads to a model which are trained the train as well the data but unfortunately as unseen not as a badly new data too, so that overfitting occurs [14].

Various types of illustrations as for overfitting could be considerable are as below given:

- *Dropout*
  During the training process some neurons are randomly dropped other neurons by forced learn new data with new features from the input data [15].
- *Batch normalization*
  The activation functions are normalizing and analyzing by adjusting the input layer by some scaled trained data. The training processes are used to stabilize and speed up with the help of normalization [16-18].
- *Pooling Layers*
  For the input image it reduces the spatial dimensions by providing the abstracted model in a representation form which overcomes the chances of overfitting the data [19].
- *Early prediction or stopping*
  It consistently monitors the performance of model after that validate the data as during the training process and when validation error occurs its stopped training and improve this error frequently [20].
- *Noise Injection*
  This process consists of added some input data with some outputs which have some noise contents as such used for training purposes to make the model as in robust which prevents the slow and weak generalization. [21]

L1 and L2 normalizations

It is used to add the loss function which is based on the size of weights as computed the loss function. Basically, L1 computed the weights by specifying the feature selection which added the different weights.

Data Augmentation

In this process, as in artificially the size and diversity of datasets which is used for training when applied the random transformation like as cropping and scaling of input images that is used for training and testing purposes.

Recurrent Neural Networks and Back propagation Through Time

In the recurrent neural networks classes of neural networks are helping in modeling the sequential data as well as the input data. The RNN behaves like a human brain just simply put the neural networks for their prediction as in results [21]. In the sequential data the algorithms cannot be a neural network. In the backpropagation algorithm of machine learning which calculates the error function with respect to weight of neural networks. The various layers of machine learning with gradients it calculates the partial order derivative of weights with respect to errors.it decrease the error margins when applied training to them.

IV. PROPOSED MODEL ARCHITECTURE

In this proposed work various deep learning models are used for classifying the disease at an early stage. Deep learning models such as LeNet in the brain stroke MRI of different images as in form of dataset are collected by following the preprocessing images. As in Figure 1 brain stroke diseases are analyzed to improve the accuracy by loading the dataset of brain stroke prediction. The proposed model of deep learning is evaluated as in comparison with the other machine learning models.

Proposed Workflow

In this proposed work the flow chart for brain stoke prediction is as shown by following **Fig 1** and **Fig 2** is as:

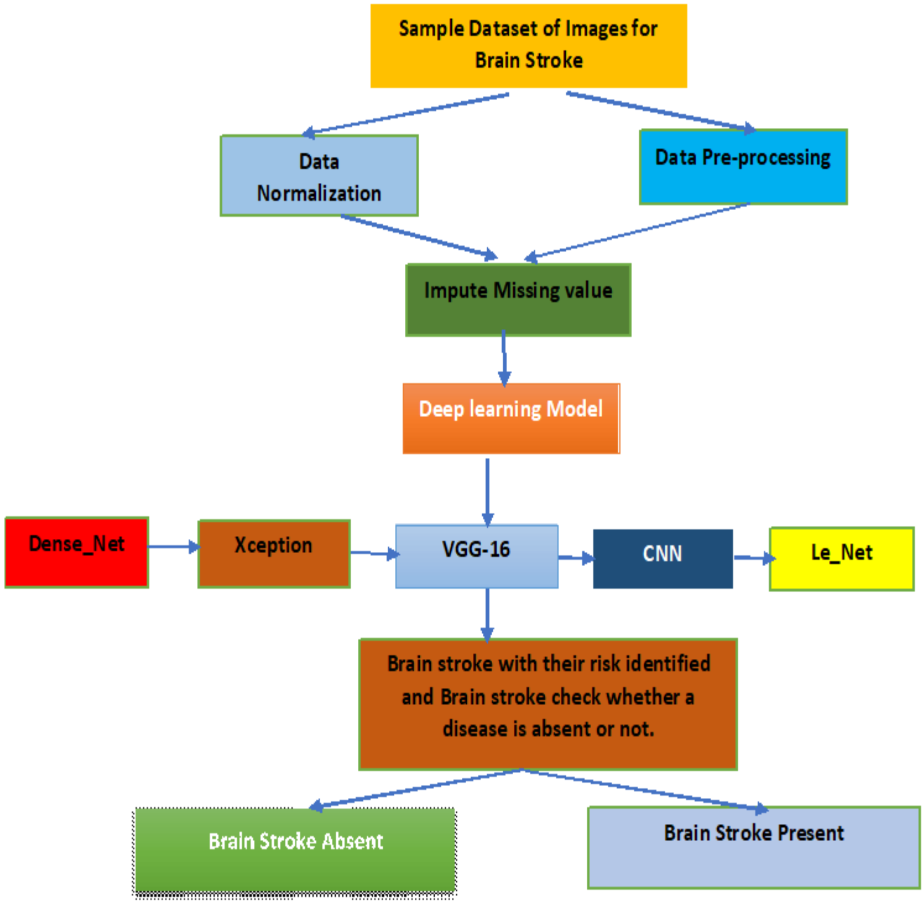

Fig 1. Proposed flow Chart

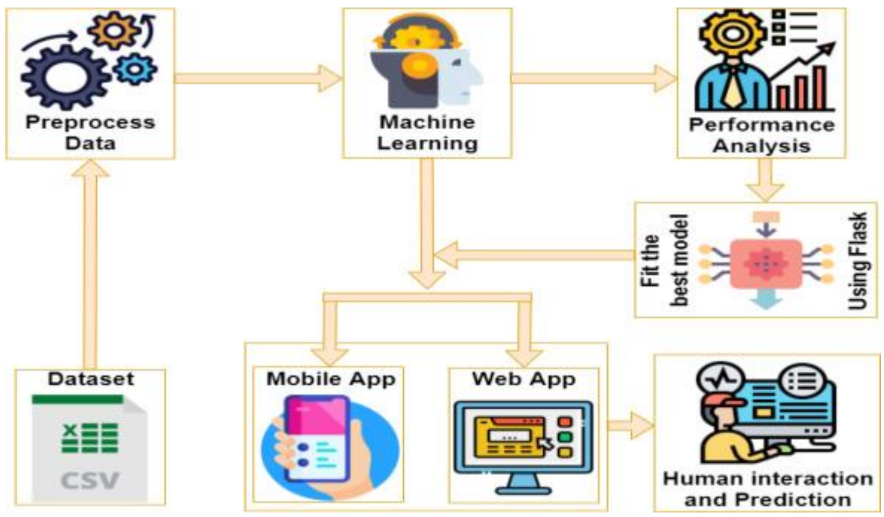

Fig 2. Graphical flowchart for basic operations used in Brain stroke

- Input: Load the Brain Stroke images Dataset (CSV)
- Processing Steps: To compute Pre-processing using Machine Learning Training then after their Performance Analysis
- Output: Using mobile and web applications Deploy model via Flask
- End Goal: Prediction and interaction in humans through mobile and web platforms.

Input dataset and preprocessing

In this proposed work with the help of MRI and image detection techniques using deep learning the model is trained and tested after that loaded into the machine to produce the results. All the dataset samples which are in images form are used to perform the images as in on scaling reduce overfitting by resizing the images as set in different pixels form as shown by **Fig 3**.

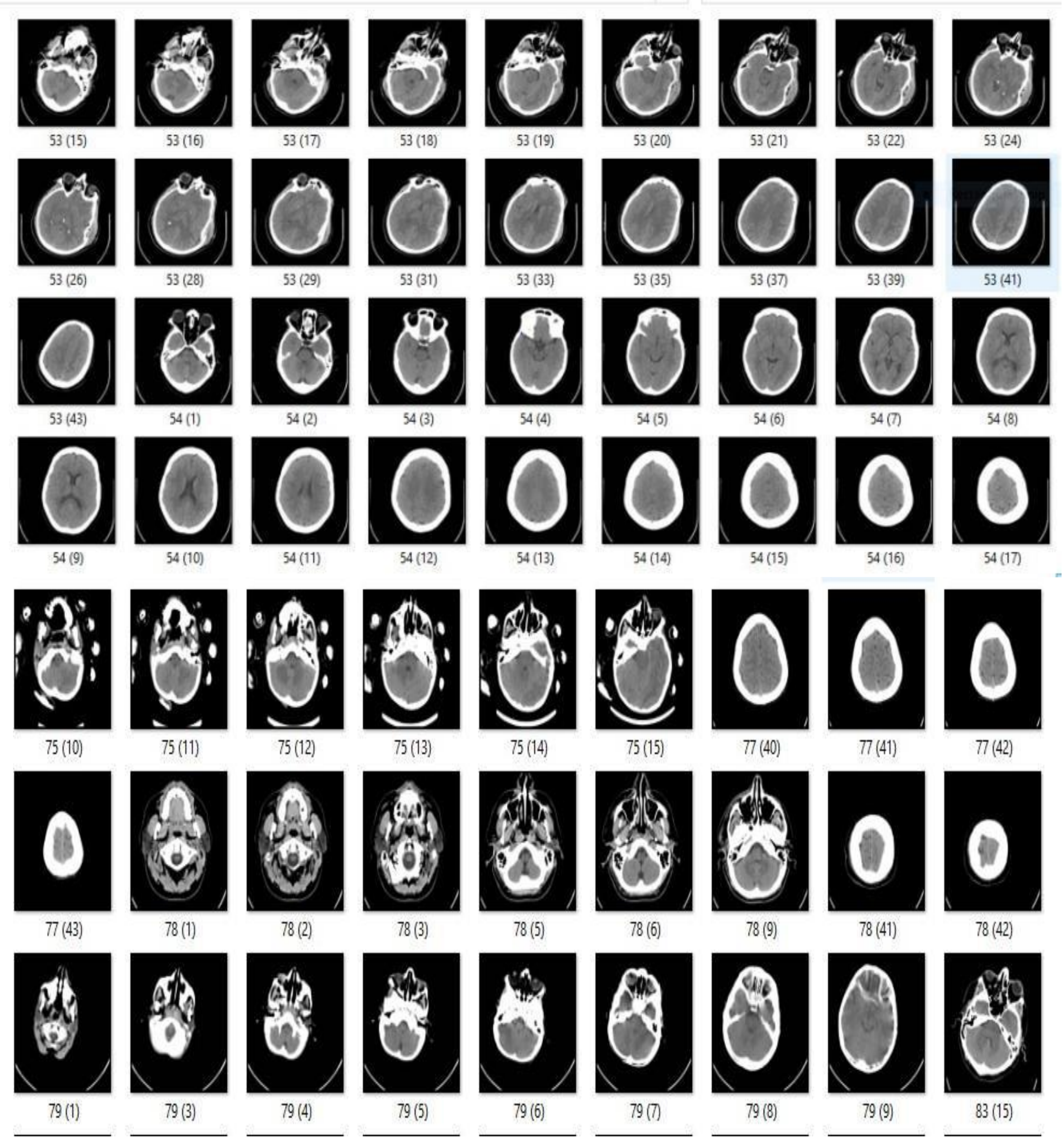

Fig 3. Sample images as in Dataset

MRI Dataset

In this dataset the brain stroke used the normal and haemorrhagic as by the different samples collected. the dataset contains huge samples for images [17].

Pre-processing

In this step medical image processing and mining of data is done by the process of preprocessing. Firstly, collect the raw data as in form of samples as the human under stable form and remove the noise and missing information from the samples. MRI images are preprocessed by its intial stage to collecting the different image samples which have high resolution. The samples which are in the form of images have RGB color value. various preprocessing algorithms and techniques to obtain accuracy in MRI images.

Dataset processing by balance and unbalance samples

It is one of the main challenges due to the poor performance and quality of data which was collected at the time of diagnosis. The basic evaluation measures are by distribution of the classes. various methods and techniques are used to compute the unbalanced and noisy data as shown by **Fig 4.**

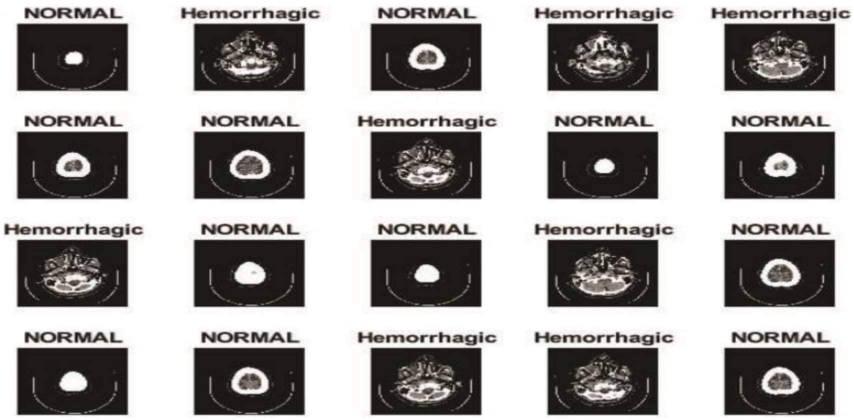

Fig 4. Images of normal and haemorrhagic states of Brain

V. DEEP LEARNING METHODS

As per the different perspectives, deep learning has ability to understand and learn the concepts of data learning by using artificial Intelligence. Deep learning algorithms are to compute and solve the different research problems in healthcare and medical field [18]. As the advancements in artificial intelligence to solve the healthcare issues by the intelligence tools and technologies that were used as. In medicine or disease, machine learning gives better results in terms of accuracy. In the deep learning algorithms, several hidden layers that support the complex and nonlinear problems of deep learning [19].

In the proposed work various deep learning and IOT based techniques tools employed for this current study. In this model a complex and preprocessed dataset is implemented to detect the brain stroke at an early stage. Deep learning has emerged as a cornerstone in artificial intelligence and computer-based learning, revolutionizing various fields with its remarkable capacity to extract insights from data. This powerful technique has gained widespread adoption, becoming the go-to approach for tackling complex problems across diverse domains.

In recent years, researchers have witnessed significant breakthroughs in applying deep learning algorithms to address challenges in areas such as sentiment analysis, object detection, and financial modeling. The medical field, in particular, has experienced a transformative impact from the integration of artificial intelligence and Internet of Things (IoT) technologies [21]. These advanced models offer the promise of enhanced efficiency and precision in medical diagnostics and decision-making processes. At the heart of deep learning's effectiveness lies its sophisticated architecture, which incorporates multiple hidden layers to capture intricate data representations [13]. This layered structure enables the construction of computational models capable of unraveling complex, non-linear relationships within the data, leading to more nuanced and accurate solutions. The research at hand proposes a novel approach to brain stroke prediction, leveraging an array of state-of-the-art deep learning algorithms. This model employs a selection of advanced neural network architectures, including LSTM, DenseNet-121, Xception, VGG16, LeNet-5, and ResNet-50. These classifiers process preprocessed medical images to distinguish between normal brain scans and those indicative of stroke conditions. By harnessing the unique strengths of each of these deep learning models, the study aims to conduct a comprehensive performance analysis, potentially uncovering new insights into the efficacy of different architectures for this critical medical application. The subsequent sections of the research delve into the intricacies of each model, exploring their individual contributions to the task of brain stroke prediction. In the field of AI and computer assisted learning to learn new concepts through the deep learning as in the make the data changes. In the various fields to solve the research problems the deep and machine learning algorithm are observed and computed. As we know, the AI approaches many of applications such as sentiment analysis, disease detection, online spam, finance and others. Due to the advancement in technologies the AI base and IOT based model are more benefited in terms of medicine. For CNN to build the computational model's various hidden layers are used to represent the data by deep learning algorithms.

In the current study, too analyze and detect the brain stroke their performance is measured by deep learning algorithms. Disease prediction is based on the input image that is normal, or stroke related. The various models include and implemented in this proposed work such as DenseNet-121, xception, VGG16, LENET5 and ResNet-50 etc.

DenseNet-121

It is the type of CNN through by which Dense Blocks are used to create the dense connections as for different layers. the architecture is known as Dense which employs a unique concatenation at each layer. Every layer connects with other layer in a feed forward manner like as CNN.it allows high parameters efficiency to achieve connectivity patterns which allows networks for good performance. It used the concepts of mapping which have a feature map that separate and reduce the blocks of pooling in the various convolutional layers [15]. the features maps is separating from the dense block through DenseNet-121 architecture as shown by f **Fig 4**.

Xception

Xception is a deep convolutional network that uses Depth wise Separable Convolutions. The name "Xception" stands for "extreme inception," as it extends the core concepts of the Inception algorithm. Inception initially applied 1 × 1 convolutions to the input to compress it, followed by applying each of input spaces by filtering the different types of depth space [16]. its works on the model of 1*1 convolution that compress the features in a pointwise convolution.it is shown by **Fig 5**.

VGG-16

It is a series of different convolutional models that is based on the visual geometry group. 16 refers to the total 21 layers each of the model. The architecture of VGG16 consists of 5 max pool layers, 3 dense layers and sixteen layers that have some learnable parameters layers. The activation functions have some weighting values which are working through learner layer [18]. It is detailed in **Fig 6.**

LeNet-5

It is a neural network based on the network design which have some created character recognition applications. It has normally five learning layers. [49-51]. It has many layers that is discussed by their architecture in the proposed work shown by **Fig 7**.

VI. RESULTS AND DISCUSSIONS

The dataset has been collected from the online public repository Kaggle .in this dataset the various clinical parameters of the patient are collected from the patient record. Various records and attributes are represented by the columns and target feature columns using the common properties selected from the dataset.

In the below **Table 1** and **Table 2** the computed the dataset samples and no of epochs rates and as accordingly the ratio is calculated with the help of different regularization methods employed.

Table 1: Attributes Dataset

Set_ of _Faetures	**Description**
Age	40 and above
Hytense	0 -Absent 1- present
BS	0-isc 1-haemorrhagic
Marriedever	1-Yes 0-No
Work_type	0-No 1-Child 2-prijob 3-Selfwork 4-Govt
Type_ Residence	0-Urban 1-Rural
glucose_level_Avg	Glu level
BMI	Measured how much
Sta_Smoking	0-Never 1-Smokes 2-little bit_smoked
Stroke	0-No stroke 1-Suffered stroke

As in the algorithm and results according to age-based samples are computed the various attributes of patients are collected for testing and training the results to compute the brain stroke results. The standard value and mean deviation are computed by the statistics of varies means. The count values signify the results as according to the samples of brain stroke and the confusion matrix performance.

Table 2: No of rates and Epochs rate

No _of_Rates	No of Ratios
Dropout rate	0.7
Number of epochs	199
T	7
P	11
DP	4

In the below **Table 3** deep learning analysing with the help of the different models and methods used that is called as deep learning hybridization. In the proposed table the classes are taken as an account to compute the brain stroke prediction as an early stage of disease and achieved accuracy by applying the deep learning methods and tools. The various sample images used for help to compute the results as per their prediction rate. The mean and standard deviation is calculated by the taking the total sample rate.

Table 3. No of classes as per deep learning model is used

Classes	Proposed model (Denesnet, Resnet, Xception, RNN)	Deep learning Hybridization	Brain stroke prediction rate
C1	96	88	88
C2	94	86	87
C3	92	79	85
C4	93	88	88
C5	96	77	85
C6	98	75	76
C9	97	86	79
C6	92	78	80
C9	96	85	90
C10	95	88	84
C11	94	86	88
Mean	98.8	85.67	90.4
Standard ±4.8 deviation		±3.9	±3.8

In the below table as per patient instances and attributes various values and sign are to be collected to detect the disease at an early stage. The standard deviation computed by means of different classes. The mean and mode are calculated the various attributes of sample. The left hand and right hand mean to detect the brain stroke in patient for which phase to be occurred as shown by **Table 4** and f **Fig 5**.

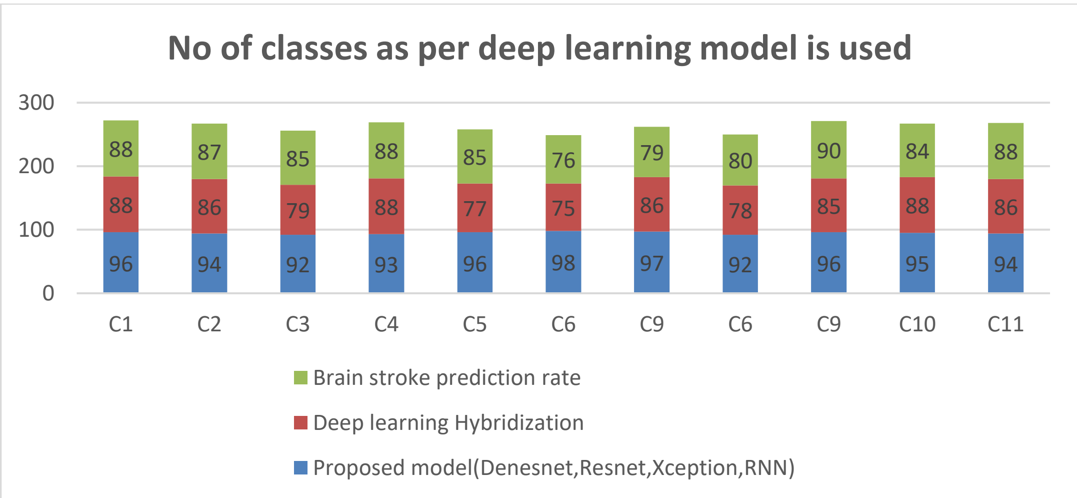

Fig 5. Deep Learning Model results

Table 4. Attributes as per the samples of patients

	Left_hand	Right_Hand	Left_hand	Right_Hadd	Left_hand	Right_Hand
C1	78	82.5	87	97	91	92
C2	81	80.1	87	97	82	80
C3	76	83.3	97	89	80	78
C4	78	84.2	97	96	72	76
C5	82	70	77	98	80	83
C6	86	82	90	90	87	82
C9	77	82	91	91	78	82
C6	88	82.3	91	92	83	86
C9	78	83	97	93	81	83
C10	79	82.4	90	78	82	83
C11	79	84	91	92	82	86
Mean	78.09	87.05	97.7	94.3	81.27	88.2
Standard deviation ±2.3			±3.2	±3.3	±4.1	±1.8

The below **Table 5** and **Fig 6** the stroke and non-stroke according to samples for the disease effected patients. The various datasets are collected used in oversampling the classes data as for obtained accuracy.

Table 5. Results of patients as per differentiating samples of stroke or non-stroke

Classes	No-stroke	Stroke	No-stroke	Stroke
ALL dataset	1650	170	1200	50
Before Over Sampling data	1650	170	1200	50
After Over Sampling_data	1650	170	1200	50

Table 6. Normal and hemorrhagic samples

Name of class	Normal	Haemorrhagic
Before_augumented	3460	2200
After_augumented	2360	2300

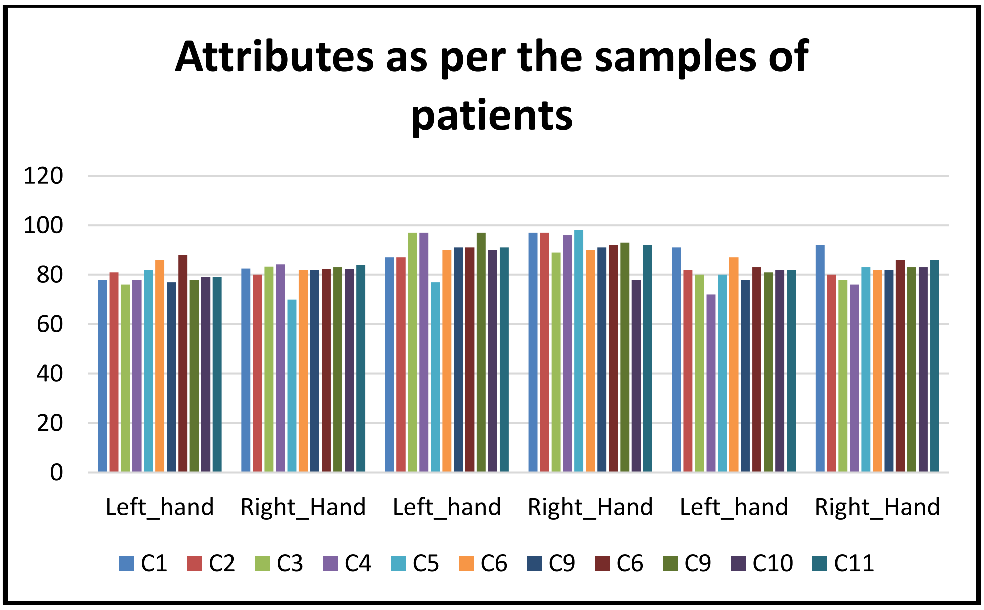

Fig 6. Results based on the Samples of Brain Stroke

As in the below **Table 6** and **Table 7** normal and hemorrhagic samples are computed for patients as per classes obtained or detecting the disease at an early stage and shown by **Fig 6**.

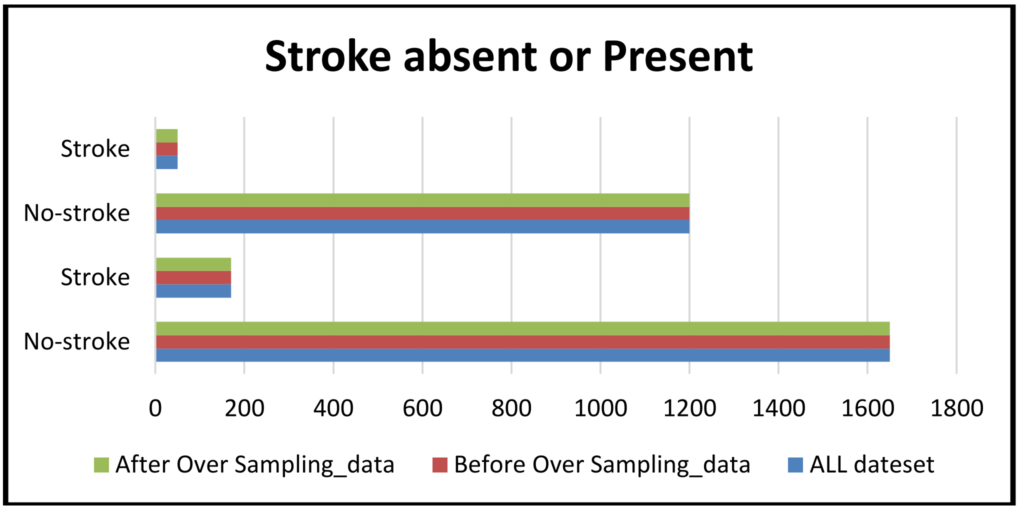

Fig 6. Results based on the Sampling data of Brain stroke

As per statistics of patient's various attributes such as hypertension, age, brain stroke effected, glucose level, MI index, stroke, diabetes, obesity etc. these attributes that are used for brain stroke prediction using the deep learning by the various models.

Table 7. Accuracy Results by Classification of Deep learning Model

Statistics	**Age**	**Hypertension**	**Brain_Stroke _effected**	**Glucose_level**	**BMI_index**	**Stroke**	**Has_diabetes or Hamme**	**Is_obesity**
Count	50-60	52.33	2300	4944	53.4	2300	2500	4944
Mean	42.56	0.094	0.05	101.72	56.3	2400	0.179	0.456

The various attributes and feature set are considered for the brain stroke prediction by the various samples collected as shown by **Table 8**.

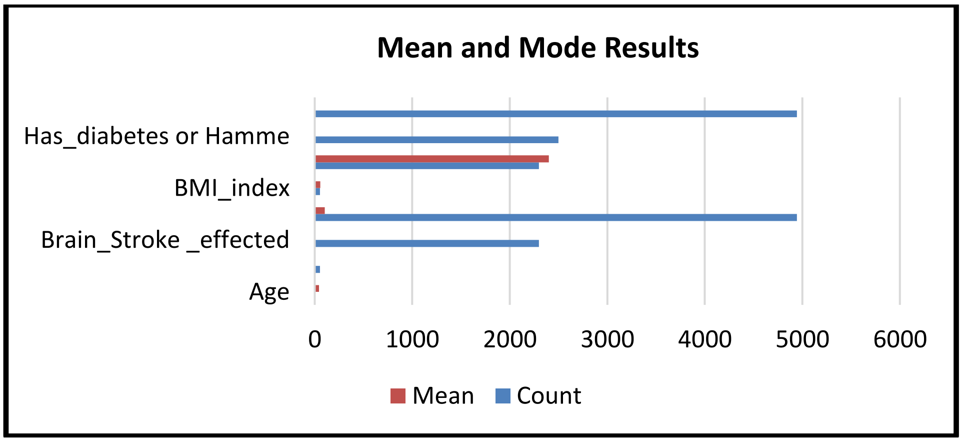

Fig 7. Mean and Mode Results

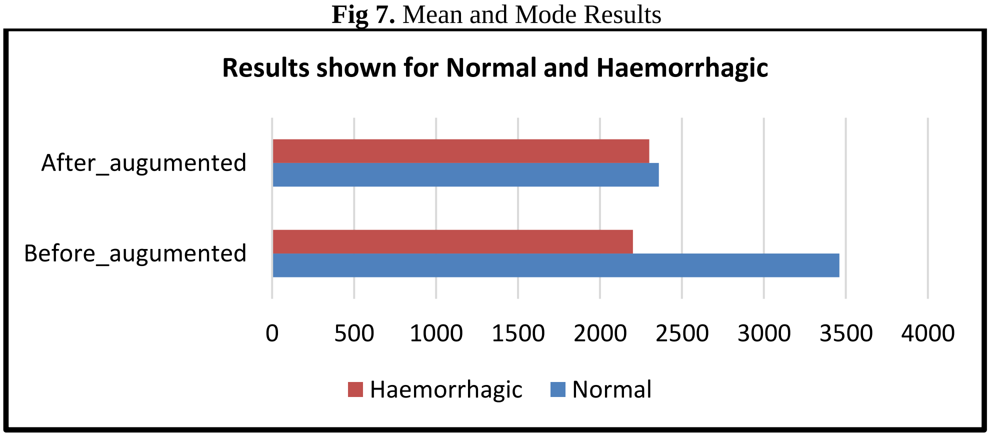

Fig 7. Results for augmentation

Table 8. Features and Metrics for the Stroke Dataset

Feature_Set	Gender
Gender	1-Male 2-Female 3-Other

In the below **Table 9** various attributes and their feature set are collecting to compute the results as mention below the sample of disease effected patients0 as shown by **Fig 8**.

Table 9. BMI features Mean and Standard Deviation

Stat_Value	Age_level_brainstoke	Avg_glucose_leels	BMI_Samples	Stroke
Count_value	2200	2200	2200	2200
Mean_value	45.667	112.34	28.6104	0.03456
Standard_value	26.134	43.29359	6.89	0.2045

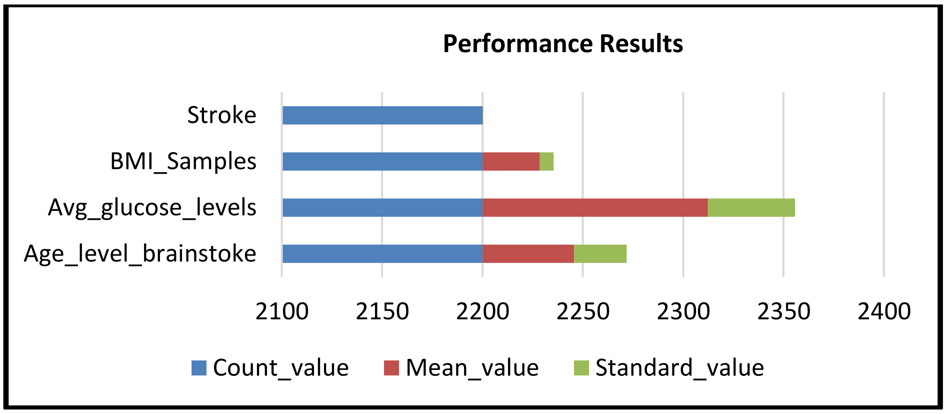

Fig 8. Results for classification accuracy

Algorithm for Lenet and RNN For Brain Stroke Detection

- Firstly, load Brain and MRI Dataset
- As per Dataset train the data, validate and Testing tools.
- Pre-process the Data according to dataset, Resize the dataset as per image.
- Normalize the pixel value to range from [0,1].
- Define the LeNet Model as per input layer size (32,30,1)
- Conv layer 1: filters 6, kernel size (5,5), Relu activation size.
- Pool layer with number 1 and max size (2,2).
- Feature_maps are flatten and sizing it by fully connected layer that is 84 neurons.
- End results with output layer that calculated (stroke prediction/ No stroke)
- After the completion compile the model.
- Train the model by resizing the Epochs values.
- Evaluate the image and test the train data as per compute the final accuracy.
- Define and compile the RNN model.
- Compute accuracy by weights and get the classification results according to stroke prediction in brain.

VII. CONCLUSION

Stroke is one of the most feared neurological conditions worldwide due to its potential to cause death or permanent physical disability. Prompt diagnosis is therefore essential for both patients and healthcare providers. Artificial intelligence (AI) has become integral to various aspects of human life, and its application in identifying health-related issues can significantly expedite the diagnostic process, leading to safer outcomes. In this study, we utilized AI alongside machine learning and feature selection techniques to enhance the reliability of our results. Future research aims to develop supplementary support algorithms that leverage AI to further boost the dependability of findings. There is a notable correlation between the outcomes of multiple laboratory tests and the incidence of stroke. By developing a prediction algorithm that uses data from lab tests to estimate stroke risk, we may be able to save lives. Our work involves creating a prediction model with an 88% accuracy rate using convolutional neural network (CNN) techniques. This model can predict strokes in real time when integrated with electronic health records. However, due to the nature of our data, we were unable to distinguish between ischemic and hemorrhagic strokes. Future research will aim to develop prediction models for different types of strokes by utilizing data that provides detailed information on each type.

CRediT Author Statement

The authors confirm contribution to the paper as follows:
Conceptualization: Devi T, Ritu Aggarwal, Swathiramya R, Padmashri N, Ebinezer M J D, Suje S A; **Methodology:** Devi T, Ritu Aggarwal, Swathiramya R, Padmashri N, Ebinezer M J D, Suje S A; **Writing- Original Draft Preparation:** Devi T, Ritu Aggarwal, Swathiramya R; **Validation:** Ebinezer M J D, Suje S A; All authors reviewed the results and approved the final version of the manuscript.

Data Availability

No data was used to support this study.

Conflicts of Interests

The author(s) declare(s) that they have no conflicts of interest.

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Competing Interests

There are no competing interests

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