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BRAIN STROKE PREDICTION USING CNN

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ABSTRACT
Stroke is a critical medical condition caused by the interruption of blood supply to the brain, leading to severe neurological damage or even death if not detected in time. Early diagnosis is essential to improve patient survival rates and reduce long-term disabilities. This project presents a deep learning-based system for automatic stroke detection using brain CT scan images. The proposed approach utilizes Convolutional Neural Networks (CNNs) to classify images into Normal and Stroke categories by learning important spatial features from medical images. A pretrained deep learning model, MobileNetV2, is employed to enhance feature extraction and improve classification performance. The system is trained on a dataset of CT scan images and evaluated using performance metrics such as accuracy, precision, recall, and F1-score. In addition to the CNN model, traditional machine learning algorithms such as Random Forest, Support Vector Machine (SVM), and Logistic Regression are implemented for comparative analysis. The system is integrated into a Flask-based web application that allows users to upload brain scan images and receive real-time predictions along with confidence scores. Experimental results demonstrate that the proposed model achieves high accuracy and reliable performance in stroke detection. This approach helps in reducing diagnostic time, minimizing human error, and supporting healthcare professionals in making faster and more accurate clinical decisions.

INTRODUCTION
Brain stroke, also known as a cerebrovascular accident (CVA), is a serious medical condition that occurs when the blood supply to the brain is disrupted, leading to a lack of oxygen and nutrients in brain cells. This condition can result in permanent brain damage, disability, or even death if not diagnosed and treated at an early stage. Stroke is one of the leading causes of mortality and long-term disability worldwide, making early detection and timely intervention extremely important in clinical practice.

Traditionally, stroke diagnosis is performed through clinical evaluation and medical imaging techniques such as Computed Tomography (CT) scans. CT scans are widely used due to their speed and effectiveness in identifying brain abnormalities, especially in emergency situations. However, manual interpretation of CT scan images requires expert knowledge and can be time-consuming, particularly in hospitals with limited radiology specialists. This may lead to delays in diagnosis and increase the risk of incorrect or late treatment.

With the rapid advancement of Artificial Intelligence (AI) and deep learning, automated systems have emerged as powerful tools for medical image analysis. Among these, Convolutional Neural Networks (CNNs) have shown exceptional performance in image classification tasks due to their ability to automatically extract meaningful features from complex visual data. CNNs can learn patterns from medical images and assist in detecting abnormalities with high accuracy and consistency, reducing dependency on manual analysis.

In this project, a deep learning-based approach is proposed for the detection of brain stroke using CT scan images. The system is designed to classify images into two categories: Normal and Stroke. A pretrained CNN model, MobileNetV2, is utilized to enhance feature extraction and improve classification performance through transfer learning. This approach enables the model to learn effectively even with a limited dataset and improves generalization.

In addition to deep learning, traditional machine learning models such as Random Forest, Support Vector Machine (SVM), and Logistic Regression are also implemented using clinical data to compare performance. The entire system is integrated into a Flask-based web application that allows users to upload brain CT scan images and receive real-time predictions along with confidence scores. This combination of deep learning and web deployment provides a practical and efficient solution for assisting healthcare professionals in stroke diagnosis.

This project focuses on developing a deep learning-based system using Convolutional Neural Networks (CNNs) to detect brain strokes from CT scan images. The proposed model is trained on a dataset of brain scans to classify images into Normal and Stroke categories. The primary objective of this research is to design an AI-driven tool that can assist medical professionals in diagnosing strokes more effectively. By leveraging deep learning techniques, the system aims

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to enhance the accuracy and speed of stroke detection. This approach helps reduce misdiagnosis rates and enables timely medical intervention, which is crucial in emergency conditions. The system is particularly useful in healthcare settings with limited access to radiology experts, ensuring faster and more reliable diagnosis. To further improve performance, a pretrained CNN model (MobileNetV2) is used for feature extraction, and the model is evaluated using metrics such as accuracy, precision, recall, and F1-score.

RELATED WORK

Early approaches to stroke detection primarily relied on traditional image processing techniques such as thresholding, edge detection, and region-based segmentation. Although these methods were useful for basic analysis, they were highly sensitive to noise, variations in image quality, and complex anatomical structures, which limited their reliability in real-world clinical applications. To overcome these limitations, machine learning techniques such as Support Vector Machines (SVM) and Random Forests were introduced. These models utilized handcrafted features extracted from medical images and clinical data to perform classification. While these methods showed moderate success, their performance depended heavily on feature engineering and lacked robustness when applied to diverse datasets.

With the advancement of deep learning, Convolutional Neural Networks (CNNs) have become a powerful tool in medical image analysis. CNNs automatically learn hierarchical features from images, eliminating the need for manual feature extraction. Several studies have demonstrated that CNN-based models can achieve high accuracy in detecting abnormalities in brain CT scan images, making them highly suitable for stroke detection tasks. Pretrained models such as MobileNet, VGG, and ResNet have been widely used through transfer learning to improve performance, especially when the available dataset is limited.

Recent research has focused on applying deep learning techniques specifically for brain stroke detection using CT scan images. These approaches aim to classify brain images into normal and abnormal categories, assisting medical professionals in faster and more accurate diagnosis. Studies have shown that deep learning models outperform traditional machine learning methods due to their ability to capture complex spatial patterns in medical images. Additionally, integrating deep learning models into web-based applications has enabled real-time prediction and improved accessibility in clinical environments.

Despite these advancements, challenges such as class imbalance, limited dataset availability, and variability in medical images still affect model performance. Addressing these challenges through data augmentation, transfer learning, and improved model architectures can further enhance the accuracy and reliability of stroke detection systems. The present work builds upon these developments by implementing a CNN-based approach using MobileNetV2 for efficient and accurate stroke classification from CT scan images.

PROBLEM STATEMENT

Stroke, also known as a cerebrovascular accident (CVA), is a life-threatening medical condition that occurs when the blood supply to the brain is disrupted, leading to brain tissue damage. It is one of the leading causes of death and long-term disability worldwide. Early detection of stroke is crucial for effective treatment and improved patient outcomes. However, traditional methods of diagnosis rely heavily on manual interpretation of brain CT scan images by medical experts, which can be time-consuming and prone to human error. In emergency situations, even small delays in diagnosis can significantly impact patient survival and recovery.

Additionally, the availability of skilled radiologists may be limited in many healthcare settings, especially in rural or resource-constrained environments. The increasing volume of medical imaging data further adds to the workload of healthcare professionals, making manual analysis inefficient and less reliable. Variations in image quality, noise, and subtle differences in stroke patterns can also make accurate diagnosis challenging.

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PROPOSED SYSTEM

The proposed system presents a deep learning-based approach for automatic detection of brain stroke using CT scan images. The system utilizes Convolutional Neural Networks (CNNs) to classify brain images into two categories: Normal and Stroke. CNNs are highly effective for image classification tasks as they can automatically extract important features from medical images without the need for manual feature engineering. This makes them suitable for analyzing complex brain CT scan images and identifying stroke-related patterns.

In this work, a pretrained deep learning model, MobileNetV2, is employed using transfer learning to improve feature extraction and classification performance. The use of a pretrained model allows the system to leverage knowledge learned from large-scale image datasets, thereby enhancing accuracy and reducing training time, especially when the available dataset is limited. The model is trained on labeled CT scan images and learns to distinguish between normal brain conditions and stroke-affected regions based on image patterns.

The system follows a structured pipeline that includes image preprocessing, model training, and prediction. In the preprocessing stage, input CT scan images are resized to a fixed dimension and normalized to ensure consistency and improve model performance. These processed images are then passed to the CNN model, where deep features are extracted and used for classification. The final output of the model is a binary prediction indicating whether the input image represents a normal brain or a stroke case, along with a confidence score.

To enhance usability, the proposed system is integrated into a Flask-based web application. This interface allows users to upload CT scan images and receive real-time predictions in a simple and user-friendly manner. The system provides quick and reliable results, reducing the dependency on manual interpretation and assisting healthcare professionals in making faster and more accurate decisions. Overall, the proposed system improves the efficiency, accuracy, and accessibility of stroke detection using artificial intelligence.

SYSTEM ARCHITECTURE

The system architecture of the proposed stroke detection system consists of the following modules:

1. Image Upload Module

Users upload brain CT scan images through a Flask-based web interface. The system accepts image files and prepares them for processing.

2. Preprocessing Module

The uploaded images are resized to a standard dimension (224×224 pixels) and normalized to ensure consistency and improve model performance.

3. CNN Model Module

The pre-processed images are passed to a Convolutional Neural Network based on MobileNetV2. The model extracts deep features from the images and performs classification.

4. Prediction Module

The model outputs a binary prediction:

- Normal
- Stroke
  along with a confidence score indicating the probability of the prediction.

5. Web Interface (Flask)

The results are displayed on a user-friendly web interface, allowing users to view predictions in real time.

OBJECTIVES

The primary objective of this project is to develop an automated and reliable system for detecting brain stroke using CT scan images and deep learning techniques. The specific objectives are as follows:

- To design and implement a Convolutional Neural Network (CNN)-based model for stroke detection from brain CT scan images.
- To classify brain images into two categories: **Normal and Stroke** using deep learning techniques.
- To apply transfer learning using a pretrained model (MobileNetV2) to improve feature extraction and model performance.
- To evaluate the model using performance metrics such as accuracy, precision, recall, and F1-score.
- To compare the performance of the CNN model with traditional machine learning models such as Random Forest, Support Vector Machine (SVM), and Logistic Regression.
- To develop a user-friendly web application using Flask that allows users to upload CT scan images and receive real-time predictions.

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- To reduce diagnostic time and assist healthcare professionals in making faster and more accurate decisions.

METHODOLOGY

The methodology for brain stroke detection using deep learning involves several key steps. First, a dataset of brain CT scan images is collected, consisting of two classes: Normal and Stroke. The stroke class includes both ischemic and hemorrhagic cases combined into a single category for binary classification.

In the preprocessing stage, all input images are resized to a fixed dimension (224×224 pixels) and normalized to ensure consistency and improve model performance. Data augmentation techniques such as rotation, flipping, and zooming may also be applied to increase dataset diversity and reduce overfitting.

A Convolutional Neural Network (CNN) model based on MobileNetV2 is used for feature extraction and classification. Transfer learning is applied by using pretrained weights, which allows the model to learn effectively even with a limited dataset. The model is trained on the processed images to classify them into Normal and Stroke categories.

The performance of the model is evaluated using metrics such as accuracy, precision, recall, F1-score, and AUC. The trained model is then integrated into a Flask-based web application, enabling users to upload CT scan images and receive real-time predictions along with confidence scores. This methodology ensures an efficient, accurate, and practical system for automated stroke detection.

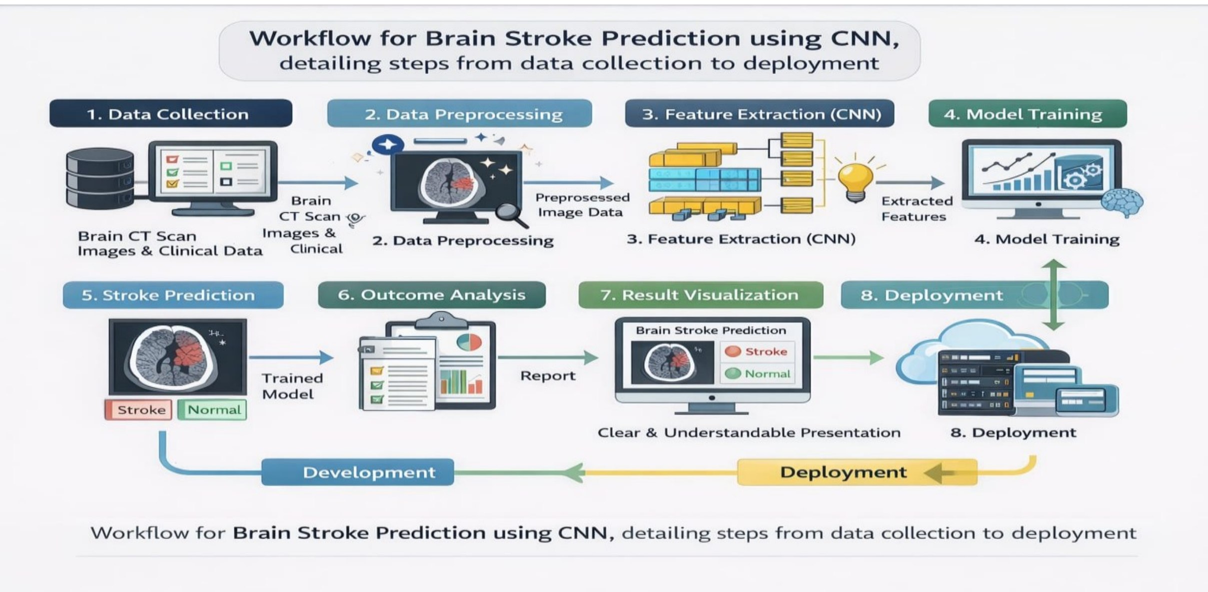

Figure :Workflow of brain stroke prediction using CNN, detailing steps from data collecting to deployment.

ALGORITHM

Algorithm: Brain Stroke Detection using CNN
Input: Brain CT scan image
Output: Classification result (Normal / Stroke) with prediction probability
Step 1: Upload the brain CT scan image through the system interface.
Step 2: Validate the input image format (PNG/JPG).
Step 3: Resize the image to a fixed size (224 × 224 pixels).
Step 4: Normalize pixel values to improve model performance.
Step 5: Pass the pre-processed image to the CNN model (MobileNetV2).
Step 6: Extract deep features using the pretrained convolutional layers.
Step 7: Apply classification layer to predict the class label (Normal or Stroke).
Step 8: Compute prediction probability (confidence score).
Step 9: Display the prediction result and confidence score on the user interface.
Step 10: (Optional) Store the prediction result for future reference.

EXPERIMENTAL SETUP

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The experimental setup for the proposed brain stroke detection system is based on a dataset of brain CT scan images categorized into two classes: Normal and Stroke. The stroke class includes both ischemic and hemorrhagic cases combined into a single category for binary classification. The dataset is divided into training and validation sets, typically in an 80:20 ratio, to ensure effective model learning and evaluation. All images undergo preprocessing steps such as resizing to a fixed dimension (224 × 224 pixels) and normalization of pixel values to improve consistency and model performance. Data augmentation techniques such as rotation, flipping, and zooming are also applied to increase dataset diversity and reduce overfitting.

The model is implemented using Python with deep learning frameworks such as TensorFlow and Keras. A pretrained Convolutional Neural Network (CNN) model, MobileNetV2, is used with transfer learning for efficient feature extraction and classification. The model is trained and evaluated using performance metrics such as accuracy, precision, recall, F1-score, and AUC. In addition, traditional machine learning models such as Random Forest, Support Vector Machine (SVM), and Logistic Regression are implemented for comparison. The final trained model is integrated into a Flask-based web application, allowing users to upload CT scan images and receive real-time predictions along with confidence scores.

PERFORMANCE METRICS

To evaluate the effectiveness of the proposed stroke detection system, several performance metrics are used to measure the accuracy and reliability of the model.

Accuracy: Accuracy measures the overall correctness of the model by calculating the ratio of correctly predicted instances to the total number of predictions.

Precision: Precision indicates how many of the predicted stroke cases are actually correct. It is important for understanding the reliability of positive predictions.

Recall (Sensitivity): Recall measures the model's ability to correctly identify actual stroke cases. High recall is crucial in medical applications to minimize missed stroke cases.

F1-Score: The F1-score is the harmonic mean of precision and recall, providing a balanced measure of the model's performance, especially in cases of class imbalance.

Specificity: Specificity measures the ability of the model to correctly identify non-stroke (normal) cases.

AUC (Area Under Curve): AUC evaluates the model's ability to distinguish between normal and stroke classes across different thresholds. A higher AUC indicates better classification performance.

Prediction Time: Prediction time refers to the time taken by the model to generate results for a given input image, indicating the efficiency of the system.

RESULTS AND ANALYSIS

The proposed CNN model based on MobileNetV2 effectively classifies brain CT scan images into Normal and Stroke categories. The model achieved an accuracy of approximately 88%, with high precision and good overall performance. However, the recall for stroke detection is slightly lower, indicating that some stroke cases may be missed, which can be improved in future work.

In comparison with traditional machine learning models such as Random Forest, SVM, and Logistic Regression, the CNN model performed better in handling image data due to its ability to extract spatial features. The integration of the model into a Flask-based web application enables real-time prediction, making the system practical for assisting healthcare professionals in stroke detection.

FUTURE ENHANCEMENT

The proposed system can be further improved by increasing the dataset size and handling class imbalance to enhance stroke detection accuracy, especially recall. Future work may include extending the model to multi-class classification (Normal, Ischemic, and Hemorrhagic stroke) for more detailed diagnosis. Additionally, incorporating explainable AI techniques such as Grad-CAM can help visualize model decisions and improve interpretability. The system can also be enhanced by integrating real-time deployment and combining clinical data with image analysis for more accurate and reliable predictions.

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CONCLUSION

The project demonstrates the effectiveness of deep learning techniques, particularly Convolutional Neural Networks (CNNs), in detecting brain stroke from CT scan images. The proposed model based on MobileNetV2 successfully classifies images into Normal and Stroke categories with good accuracy and reliability. The system reduces dependency on manual analysis, minimizes human error, and enables faster diagnosis, which is critical in emergency situations.

Overall, the integration of the trained model into a Flask-based web application provides a practical and user-friendly solution for real-time stroke detection. This approach has strong potential to assist healthcare professionals in early diagnosis and improve patient outcomes through timely medical intervention.

REFERENCES

1) Selma Yahiya Adam et al. “Classification of Ischemic Stroke using Machine Learning Algorithms”. In: International Journal of Computer Applications 149 (10 Sept. 2016), pp. 26–31.ISSN:09758887.DOI:10.5120/ijca2016911607.URL:http://www.ijcaonline.org/archives/volume149/number10/26035-2016911607.

2) I Aleksander. “1 - Pattern analysis—an opportunity for research and development”. In: Artificial Intelligence (1987), pp. 3–10. DOI: https:// doi.org/10.1016/B978-0-08-034112- 5.50006-1. URL: https://www.sciencedirect.com/science/chapter/monograph/abs/pii/B9780080341125500061

3) Laith Alzubaidi et al. “Review of deep learning: concepts, CNN architectures, challenges, applications, future directions”. In: Journal of Big Data 8 (1 2021), p. 53. ISSN: 2196-1115. DOI: 10.1186/s40537-021-00444-8. URL: https://doi.org/10.1186/s40537-021-00444-8.

4) AOI. Which Injuries Show Up on X-Ray, MRI, and CT Scans? Mar. 2019. URL: https://www.advancedorthopedicsinstitute.com/blog/whichinjuries-show-up-on-x-ray-mri- and-ct-scans/.