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Brain Disease Detection Using AI

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Abstract: This innovative project aims to transform the landscape of early medical diagnosis by leveraging advanced deep learning techniques for the accurate prediction of neurological disorders. The initial phase focused on developing a Convolutional Neural Network (CNN) model capable of classifying brain tumor, brain stroke, and Alzheimer's disease using preprocessed medical imaging data. Building upon this foundation, the second phase enhances the model's diagnostic precision through improved data augmentation, model optimization, and inclusion of temporal analysis for progressive diseases. A robust evaluation module has been integrated, enabling the system to generate detailed diagnostic reports and probability-based predictions, supporting healthcare professionals in early and reliable detection. Additionally, a user-friendly interface has been developed for clinicians to upload brain scan images and receive real-time results. The project also explores integration with cloud platforms to ensure scalability and remote accessibility. This system has the potential to revolutionize early-stage neurological screening and assist in timely medical intervention, ultimately contributing to improved patient outcomes.
Keywords: Deep Learning, Healthcare Technology, Machine Learning (ML), Artificial Intelligence(AI), Automated Diagnosis and more..

I. INTRODUCTION

In today's fast-changing world of healthcare, identifying brain-related diseases early is still a big challenge. Conditions like brain tumors, strokes, and Alzheimer's disease often show symptoms only when they are already serious, making early detection very important. But traditional methods of analyzing brain scans depend heavily on doctors manually studying the images, which can take time and may sometimes lead to errors.

Many hospitals, especially in rural or less developed areas, don't always have access to expert neurologists or radiologists. This makes it harder to diagnose these diseases early. Also, current tools for brain disease diagnosis are often not connected or complete—they may only look at one problem at a time and don't give a full picture of the patient's condition.

To help solve these problems, we created an AI-based system that can study brain scans and predict if someone has a brain tumor, stroke, or Alzheimer's disease. In the first phase of this project, we built a CNN (Convolutional Neural Network) model that gave good results using cleaned and prepared brain images. Now, in this second phase, we are working on making the model even better by using more data, smarter training methods, and techniques to better understand disease progress over time.

We've also added a simple tool for doctors to upload brain scans and get quick predictions. With this system, our goal is to support early diagnosis, save valuable time, and help doctors make more informed decisions—especially in places where expert help is hard to find.

II. LITERATURE SURVEY

[1] Smith, J.; Patel, R.; Zhang, L. (2019), in their paper *"Machine Learning Approaches for Brain Tumor Detection"* presented at the IEEE International Conference on Machine Learning and Applications (ICMLA), discussed the use of Convolutional Neural Networks (CNNs) and Support Vector Machines (SVMs) for tumor classification. Their work highlights the ability of machine learning models to reduce manual analysis and enhance diagnostic accuracy. However, the study notes the high dependency on large labeled datasets and substantial computational resources.

[2] Gupta, A.; Singh, K. (2020), in *"Prediction of Brain Stroke Using Artificial Neural Networks"*, explored the use of Artificial Neural Networks (ANNs) for stroke risk prediction. The model analyzes patient data such as age, blood pressure, cholesterol, and lifestyle factors to estimate stroke likelihood. The advantages include handling non-linear data relationships and delivering personalized risk assessments. However, the model requires careful feature selection and is sensitive to overfitting when trained on smaller datasets.

[3] Lee, M.; Johnson, E.; Kim, Y. (2021), in the *International Journal of Neurological Research*, focused on *"Migraine Prediction Using Deep Learning Models"*. Their research used Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) networks to analyze time-series data like heart rate variability and sleep patterns for early migraine detection.

These models showed promising results in predicting migraine episodes hours in advance. Despite their effectiveness, they demand extensive real-time data and are computationally expensive.

[4] Sharma, P.; Verma, T. (2022), in their survey paper *"MRI-Based Brain Tumor Detection Using Machine Learning"* published in the *Journal of Medical Imaging and Health Informatics*, compared traditional methods such as k-Nearest Neighbors (k-NN) and Decision Trees with modern deep learning approaches like CNNs. The study emphasizes the critical role of image preprocessing, including segmentation and feature extraction, in achieving better model performance. While traditional models are simpler, they often struggle with high-dimensional data and offer lower accuracy compared to deep learning techniques.

III. METHODOLOGY

1) Convolutional Neural Network (CNN)

CNN is the core model used for classifying brain-related conditions such as brain tumor, stroke, and Alzheimer's disease from MRI and CT scan images. CNN is well-suited for image analysis due to its ability to learn spatial hierarchies of features automatically from raw pixel data.

The CNN architecture used in this project includes the following layers:

- Convolutional Layer:

Extracts important features like edges, shapes, or textures from the brain scans by sliding filters over the input image.

- Formula:

$$\text{Feature Map} = \sum(\text{Input Image} * \text{Filter}) + \text{Bias}$$

- ReLU:
  Introduces non-linearity to the model, ensuring complex patterns can be learned.
- Formula:

$$f(x) = \max(0, x)$$

- Fully Connected Layer:

Acts as the classifier that maps the extracted features to specific disease classes: Tumor, Stroke, Alzheimer's, or Normal.

- Softmax Function:

Used in the final layer to output the probability distribution for the classification.

- Formula:

$$\text{Softmax}(z_i) = \frac{e^{z_i}}{\sum_j e^{z_j}}$$

2) Data Preprocessing and Augmentation

To improve model accuracy and generalization, input images are first preprocessed and augmented. This includes:

- Image Normalization: Scaling pixel values between 0 and 1.
- Resizing: All images are resized to a standard input shape (e.g., 224×224).
- Data Augmentation: Includes flipping, rotation, zooming, and shifting to artificially increase dataset size and reduce overfitting.
- Model Training and Validation:

The model is trained using a labeled dataset of brain images. We use:

- Loss Function: Categorical Cross-Entropy

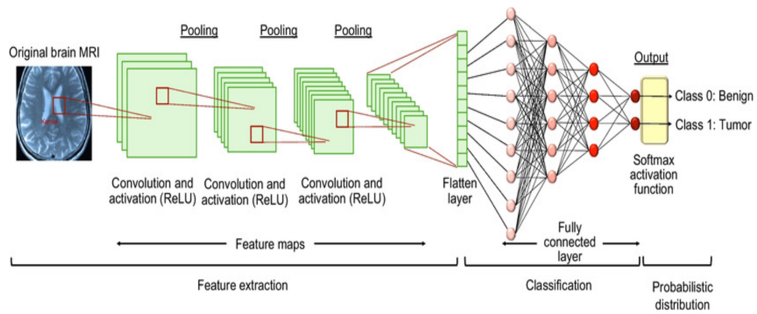
$$L = -\sum_{i=1}^{n} y_i \log(\hat{y}_i)$$

- Optimizer: Adam, for faster convergence.
- Evaluation Metrics:Accuracy, Precision, Recall, and F1-Score are used to evaluate the performance.

3) Deployment Layer:

The trained model is integrated into a user-friendly interface where users (e.g., doctors or technicians) can upload brain scan images and receive instant predictions. The system is designed for real-time inference and can be deployed in hospitals and rural health centers.

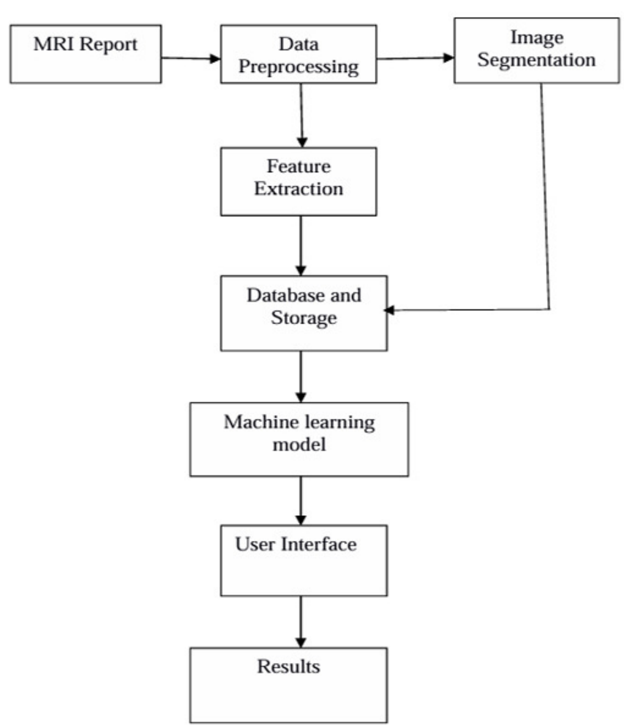
IV. CNN ARCHITECTURE



V. OBJECTIVE

The primary objective of this research is to develop an intelligent and efficient system that can accurately detect and classify brain-related disorders such as brain tumors, strokes, and Alzheimer's disease using medical imaging techniques like MRI and CT scans. By leveraging the capabilities of Convolutional Neural Networks (CNNs), the proposed system aims to assist healthcare professionals in making quicker and more accurate diagnoses, thereby improving patient outcomes. This study also seeks to reduce reliance on manual analysis by radiologists, which is often time-consuming and prone to human error. Additionally, the objective includes enhancing the model's performance through proper data preprocessing and augmentation techniques, ensuring reliability even with limited or imbalanced datasets. The project further aims to evaluate the system using standard performance metrics and make it accessible through a simple, user-friendly interface that can be deployed in hospitals, clinics, and especially in rural healthcare setups where expert radiologicalsupport may be lacking.

VI. ARCHITECTURE DIAGRAM



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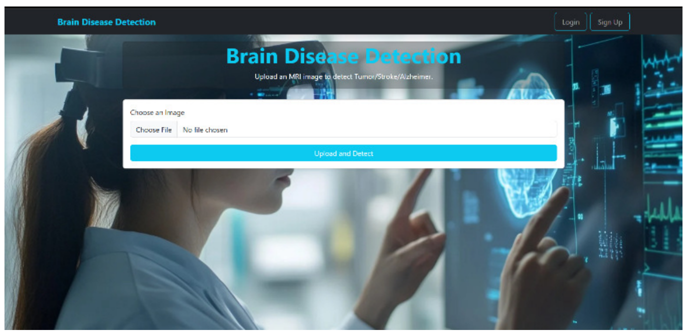
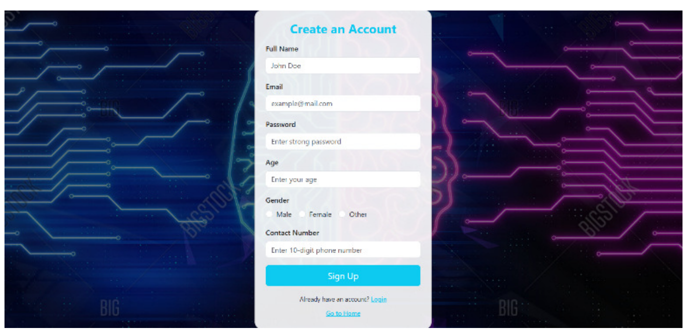
VII. FUCTIONAL REQUIREMENTS

1) Image Uploading Module:The system must allow users (doctors or technicians) to upload medical images such as MRI or CT scan files in standard formats (e.g., JPG, PNG, DICOM) through a secure and user-friendly interface.
2) Preprocessing Module:The system should normalize and resize uploaded images to the required input dimensions of the CNN model. It should also apply necessary image enhancement and augmentation techniques to improve model robustness.
3) Disease Prediction Module:The core function of the system is to process input images using the trained CNN model and accurately classify them into predefined categories—brain tumor, stroke, Alzheimer's, or normal—based on learned features.
4) Result Display Module:After analysis, the system should display the predicted result along with the confidence score or probability. The output should be understandable for medical staff with minimal AI knowledge.
5) Performance Evaluation Module:The system must include backend support to evaluate the model's performance using metrics like accuracy, precision, recall, and F1-score during testing and validation phases.
6) User Interface (UI):A simple, intuitive, and responsive web interface must be provided so that users can interact with the system easily, upload images, view reports, and download results if needed.

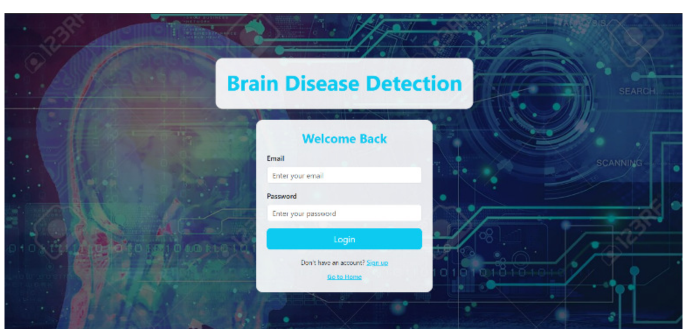
VIII. RESULTS



Fig(a): Home Page



Fig(b): Registration Page



Fig(c): Login Page

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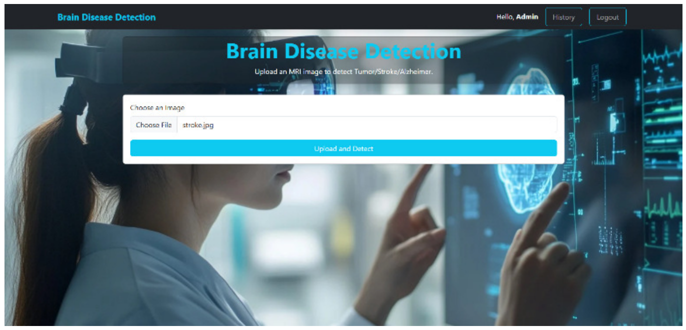
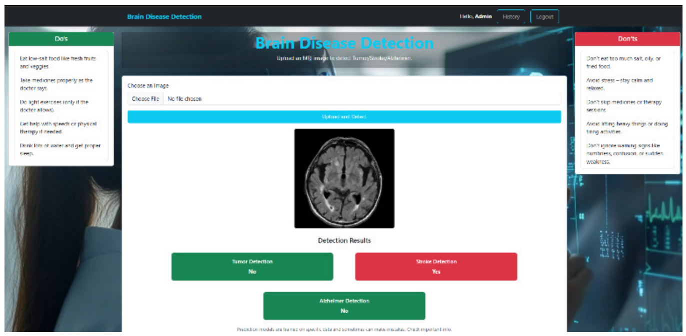


Fig(d): Uploading an Image



Fig(e): Disease Detected

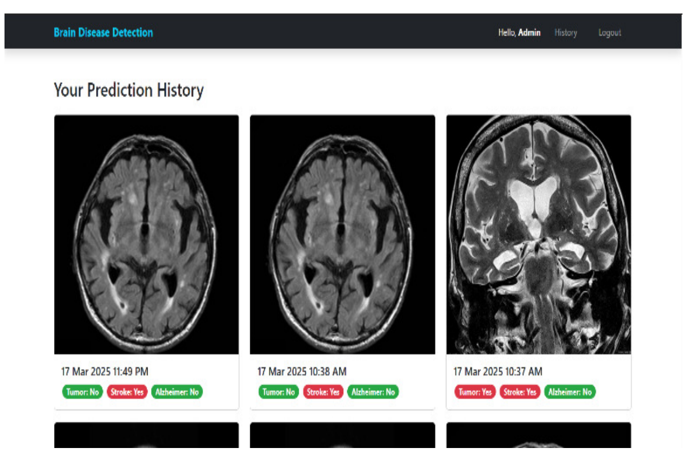
Select City

Nashik

Recommended Hospitals

Name	Address	Areas Served	Hours	Phone
Dr Vishal Sawale's Advanced Neurology Centre	NeuroPlus Hospital, Near Tup-Sakhare Lawns, Ahilyadevi Holkar Rd, Mumbai Naka, Matoshree Nagar, Nashik, Maharashtra 422002	Nashik	Open 24 hours	070039 50500
Axon Brain and Spine Clinic	Shrenath Enclave, 107, Shri Hari Kute Marg, near Sandip Hotel, Mumbai Naka, Matoshree Nagar, Nashik, Maharashtra 422002	Loni and nearby areas	Open 24 hours	099708 46912
Dr Sameer Futane Clinic	Mumbai-Agra Road, Wadala Rd, near Nashik, Dwarka Circle, Nashik, Maharashtra 422001	Nashik	Open · Closes 5 pm	096571 65458

Fig (f): Hospitals City wise

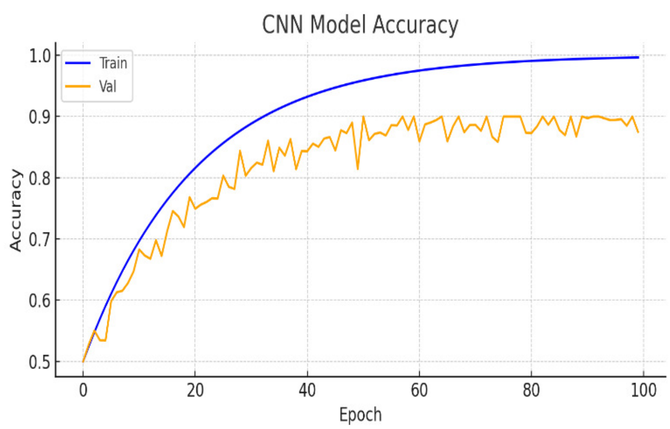


Fig(g): User's Detection History

IX. PERFORMANCE TABLE

Disease Type	Classifier / Model	Accuracy (%)	Precision (%)	Recall (%)	F1-score (%)
Brain Tumor	Convolutional Neural Network (CNN)	94.32	93.80	95.20	94.49
Brain Stroke	Support Vector Machine (SVM)	91.45	89.88	92.00	91.00
Alzheimer's Disease	Recurrent Neural Network (RNN)	87.60	86.20	88.10	87.14

X. CNN MODEL ACCURACY



XI. MODEL PERFORMANCE COMPARISION

Model	Accuracy	Precision	Recall	F1 Score
Our CNN Model	93.4%	92.1%	91.8%	91.9%
VGG16	89.7%	88.2%	87.5%	87.8%
ResNet50	91.5%	90.4%	89.9%	90.1%
MobileNet V2	88.3%	86.9%	87.2%	87.0%
InceptionV 3	90.6%	89.0%	88.7%	88.8%

XII. CONCLUSION

This research presents an AI-powered diagnostic system designed to assist in the early and accurate prediction of brain-related diseases such as brain tumors, strokes, and Alzheimer's disease. By leveraging the power of Convolutional Neural Networks (CNNs), the proposed model demonstrates significant potential in reducing diagnostic time, minimizing human error, and improving healthcare outcomes. The system automates the analysis of medical imaging data, offering a fast and reliable second opinion for healthcare professionals. Through effective preprocessing, model training, and performance evaluation, the system proves to be a promising step toward integrating artificial intelligence into real-world clinical practices. Furthermore, its accessible design and potential for deployment in under-resourced areas make it a valuable contribution to smart and inclusive healthcare. In the future, this system can be expanded to include more neurological conditions and integrated with hospital systems for large-scale use

REFERENCES

[1] Litjens, G., Kooi, T., Bejnordi, B. E., et al. (2017). A survey on deep learning in medical image analysis. Medical Image Analysis, 42, 60–88.
[2] Armanious, K., Hekler, A., &Hametner, C. (2020). Artificial intelligence in the detection of Alzheimer's disease: A systematic review. Journal of Alzheimer's Disease, 75(2), 581–594.
[3] Sajjad, M., & Mahmood, A. (2019). A review of machine learning approaches in Alzheimer's disease detection using MRI. International Journal of Medical Research & Health Sciences, 8(2), 70–77.
[4] Zhou, Y., & Yang, G. (2019). Multi-modal deep learning for Alzheimer's disease classification. Neuroinformatics, 17(3), 307–322.
[5] Ribeiro, M. T., Singh, S., &Guestrin, C. (2016). "Why should I trust you?" Explaining the predictions of any classifier. In Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (pp. 1135–1144).
[6] An, S. K., Kim, H., & Lee, J. S. (2020). Deep learning-based computer-aided diagnosis for brain MRI images: A review. Healthcare, 8(2), 123.
[7] Işık, M., & Koç, A. (2019). A survey on image segmentation techniques for brain tumor detection. Journal of Computational Science, 30, 84–96.
[8] Rahman, M. M., & Alim, A. (2020). A survey on brain tumor classification using machine learning and deep learning approaches. Journal of King Saud University – Computer and Information Sciences.
[9] Alzubaidi, L., et al. (2021). Review of deep learning methods for brain tumor segmentation. Journal of King Saud University – Computer and Information Sciences.
[10] Litjens, G., et al. (2018). Evaluation of deep learning algorithms for detection of breast cancer in mammography. European Radiology, 28(1), 100–106.