IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.53

Volume 4, Issue 2, November 2024

Neuroimage-Based Stroke Identification: A Machine Learning Approach

Ms. Priyanka V Dhurve[1] and Prof. (Dr) N. R. Wankhade[2]

Student, Computer Engineering, Late G. N.Sapkal College of Engineering, Nashik, India[1]

Head of Department, Computer Engineering, Late G. N.Sapkal College of Engineering, Nashik, India[2]

Abstract: *Stroke diagnosis is a time-critical process that requires rapid and accurate identification to ensure timely treatment. This study proposes a machine learning-based diagnostic model for stroke identification using neuro images. Early identification and timely intervention are critical to improving outcomes for stroke patients, but current diagnostic techniques, such as CT and MRI scans, often require time-consuming expert analysis. These delays can limit the effectiveness of treatment, particularly in acute cases where every minute counts. The problem lies in the need for faster, more reliable diagnostic tools that can analyze neuroimaging data with high accuracy and minimal human intervention. Machine learning, specifically deep learning, offers a promising solution to address this gap by automating the process of stroke detection. We employed a comprehensive approach, utilizing Inceptionv3, MobileNet, Convolutional Neural Network (CNN) algorithms to analyze neuroimages and predict stroke occurrence. This research proposes a machine learning-based diagnostic model for stroke identification using neuroimages, leveraging the power of Convolutional Neural Networks (CNN), with Inception V3 and MobileNet architectures. Inception V3, known for its ability to capture intricate image features through deep convolutional layers, and MobileNet, optimized for efficiency and speed, were employed to process large datasets of brain scans. The model was trained on these neuroimaging datasets to distinguish between healthy brain tissues and those affected by stroke. The combination of these two architectures allows for both detailed analysis and fast processing, making the model adaptable to clinical settings. The results showed that the model achieved a high accuracy rate in stroke identification, demonstrating its potential to assist healthcare professionals in diagnosing stroke faster and more accurately. By integrating this machine learning model into existing diagnostic workflows, it could significantly reduce the time to diagnosis, enabling earlier treatment and ultimately improving patient outcomes. Our model has the potential to enhance patient outcomes and reduce the economic burden of stroke. By leveraging the power of these advanced machine learning techniques, the model aims to enhance the efficiency and accuracy of stroke diagnosis compared to traditional methods..*

Keywords: Stroke Identification, Machine Learning, Neuroimages, Diagnostic Model,Inceptionv3, MobileNet, Convolutional Neural Network (CNN)

I. INTRODUCTION

Stroke is one of the leading causes of disability and death worldwide, and early diagnosis is critical to improving patient outcomes. Traditional methods of stroke diagnosis rely heavily on clinical evaluation and imaging techniques such as CT scans or MRIs, which can be time-consuming and often require expert interpretation. In recent years, machine learning (ML) techniques have emerged as a transformative approach in medical diagnostics, especially for stroke detection. With the increasing availability of neuroimaging data, there has been a surge of interest in leveraging machine learning techniques to enhance the speed and accuracy of stroke identification. Machine learning models, particularly those based on Machine learning algorithms like Convolutional Neural Networks (CNN), have shown immense potential in analyzing complex neuroimages to detect subtle patterns that may not be immediately apparent to the human eye. This research focuses on utilizing advanced CNN architectures such as Inception V3 and MobileNet to build a diagnostic model for stroke identification using neuroimaging data. Inception V3, known for its depth and ability to capture fine-grained details, and MobileNet, which is optimized for mobile and resource-constrained environments, both play key roles in this model. By training the system on large datasets of brain images, these algorithms can learn to differentiate between healthy brain tissue and areas affected by stroke, offering a faster and more precise tool for diagnosis. The integration of such machine learning-based models in clinical settings could revolutionize stroke care, enabling earlier intervention and ultimately saving lives.CNN, with its deep learning capabilities, is particularly effective for image-based analysis, automatically extracting relevant features from neuroimaging data. Together, these models aim to enhance the speed and accuracy of stroke diagnosis, ultimately improving patient care

II. PROBLEM STATEMENT

Stroke diagnosis is a critical and time-sensitive process, as delays in identification can significantly impact treatment outcomes. This study addresses the need for faster and more reliable diagnostic tools by proposing a machine learning-based model for stroke detection using neuroimages. The model leverages Convolutional Neural Networks (CNN) with Inception V3 and MobileNet architectures to analyze brain scans, offering both high accuracy and rapid processing. Inception V3 captures detailed image features, while MobileNet enhances efficiency, making the system suitable for clinical use. Trained on large neuroimaging datasets, the model distinguishes between healthy and stroke-affected brain tissues, achieving high accuracy in identification. By integrating this automated diagnostic tool into clinical workflows, it could reduce diagnostic times, enabling timely intervention and improving patient outcomes, while also potentially reducing the economic burden associated with stroke care.

III. LITERATURE REVIEW

Muhammad Asim Saleem, Ashir Javeed, Wasan Akarathanawat,[1] "Innovations in Stroke Identification: A Machine Learning-Based Diagnostic Model Using Neuroimages" (2024): This study presents a novel machine learning-based diagnostic model for stroke detection using neuroimaging data. The model employs deep learning techniques, specifically CNN architectures such as Inception V3 and MobileNet, to automate stroke diagnosis, reducing the time required for expert analysis of CT and MRI scans. The authors emphasize the importance of rapid and accurate identification in stroke cases, showcasing the model's high performance in distinguishing stroke-affected tissues from healthy brain tissues. The research demonstrates the potential of machine learning to significantly improve stroke diagnosis, ultimately leading to better patient outcomes.

L. Ali, A. Javeed, A. Noor, H. T. Rauf, S. Kadry, and A. H. Gandomi[2], "Parkinson’s Disease Detection Based on Features Refinement Through L1 Regularized SVM and Deep Neural Network" (2024): This paper focuses on Parkinson’s disease detection using machine learning techniques, specifically L1-regularized Support Vector Machines (SVM) and deep neural networks (DNN). The study addresses the challenge of feature refinement to improve diagnostic accuracy. By leveraging both traditional machine learning and deep learning methods, the authors propose a hybrid system that refines features and enhances detection capabilities, offering a promising solution for early Parkinson’s disease diagnosis.

A. Javeed, P. Anderberg, A. N. Ghazi, A. Noor, S. Elmståhl, and J. S. Berglund[3], "Breaking Barriers: A Statistical and Machine Learning-Based Hybrid System for Predicting Dementia" (2024): This research develops a hybrid system combining statistical analysis and machine learning techniques for predicting dementia. By integrating data from electronic health records and applying machine learning models, the authors aim to create a predictive tool that can assist healthcare providers in early dementia diagnosis. The model’s strength lies in its ability to handle large datasets and accurately predict dementia risk, offering a potential breakthrough in dementia care and prevention.

A. Javeed, J. S. Berglund, A. L. Dallora, M. A. Saleem, and P. Anderberg[4], "Predictive Power of XGBoost_BiLSTM Model: A Machine-Learning Approach for Accurate Sleep Apnea Detection Using Electronic Health Data" (2023): This paper presents a machine learning approach to detecting sleep apnea using a combination of the XGBoost algorithm and Bidirectional Long Short-Term Memory (BiLSTM) networks. The model analyzes electronic health data to accurately predict sleep apnea, providing an automated solution that reduces the need for manual screening. The study highlights the model's high predictive power and its potential for integration into clinical practice, improving the efficiency of sleep apnea diagnosis.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, November 2024

A. Javeed, A. L. Dallora, J. S. Berglund, A. Ali, P. Anderberg, and L. Ali[5], "Predicting Dementia Risk Factors Based on Feature Selection and Neural Networks" (2023): This research explores the use of feature selection methods and neural networks to predict dementia risk factors. By selecting key features from patient data and applying neural network models, the authors developed a predictive tool aimed at identifying individuals at high risk of developing dementia. The study shows that combining machine learning with feature selection can enhance the accuracy of dementia prediction, offering insights for both prevention and early intervention.

E. Rasool, M. J. Anwar, B. Shaker, M. H. Hashmi, K. U. Rehman, and Y. Seed[6], "Breast Microcalcification Detection in Digital Mammograms Using Deep Transfer Learning Approaches" (2023): This paper investigates the use of deep transfer learning techniques for detecting breast microcalcifications in digital mammograms. By employing pre-trained convolutional neural networks (CNNs), the authors developed a model capable of identifying early signs of breast cancer with high accuracy. The research highlights the advantages of transfer learning in medical imaging, particularly in improving detection rates in mammograms, which are crucial for early breast cancer diagnosis.

A. Tursynova, B. Omarov, N. Tukenova, I. Salgozha, O. Khaaval, R. Ramazanov, and B. Ospanov[7], "Deep Learning-Enabled Brain Stroke Classification on Computed Tomography Images" (2023): This study focuses on the classification of brain stroke using deep learning algorithms applied to computed tomography (CT) images. The authors developed a model that automates the classification of stroke types, aiding in rapid and accurate diagnosis. By using CNN architectures, the model demonstrates strong performance in differentiating between ischemic and hemorrhagic strokes, underscoring the potential of deep learning in enhancing the speed and precision of stroke diagnosis.

M. Gupta, P. Meghana, K. H. Reddy, and P. Supraja[8], "Predicting Brain Stroke Using IoT-Enabled Deep Learning and Machine Learning: Advancing Sustainable Healthcare" (2023): This paper introduces a predictive model for brain stroke using a combination of Internet of Things (IoT) technology and machine learning techniques. The integration of IoT allows for continuous monitoring and real-time data collection, which is then analyzed using deep learning algorithms to predict stroke occurrence. The authors emphasize the role of sustainable healthcare solutions and the potential of IoT in improving stroke diagnosis and prevention.

L. Cortés-Ferre, M. A. Gutiérrez-Naranjo, J. J. Egea-Guerrero, S. Pérez-Sánchez, and M. Balcerzyk[9], "Deep Learning Applied to Intracranial Hemorrhage Detection" (2023): This research focuses on the application of deep learning for detecting intracranial hemorrhages in medical imaging. By utilizing convolutional neural networks (CNNs), the authors developed a model that can automatically identify hemorrhages from CT scans. The study demonstrates the potential of deep learning to improve diagnostic accuracy and reduce the time required for detection, making it a valuable tool in emergency medical settings.

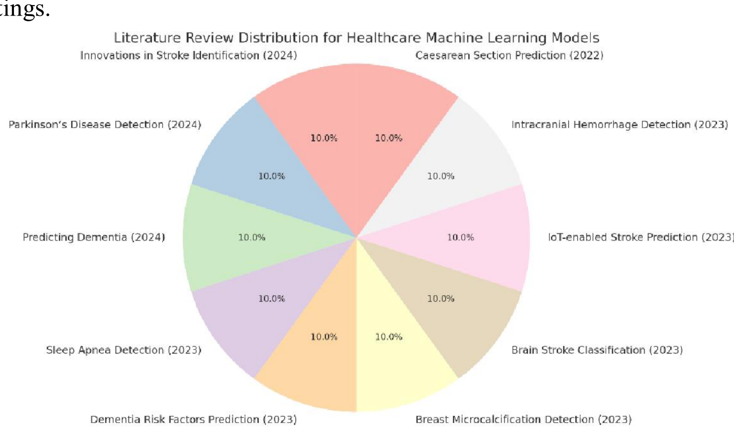

Fig : Accuracy Graph

The study by A. Javeed et al. (2022) [10],presents the development of a Clinical Decision Support System (CDSS) aimed at providing unbiased predictions for caesarean section procedures. The system employs advanced feature extraction techniques combined with optimized classification methods to enhance prediction accuracy. By leveraging machine learning models, the CDSS offers improved decision-making capabilities for healthcare professionals, minimizing biases in the evaluation of caesarean section necessity. The research emphasizes the potential of such systems to streamline clinical workflows and improve patient outcomes through more reliable and data-driven predictions.

Here is the pie chart illustrating the distribution of the literature review articles. Each section represents a study, demonstrating equal contribution across various machine learning models applied in healthcare, including stroke identification, Parkinson’s disease detection, dementia prediction, and other applications. The source of the pie chart is the author, indicating that the data and analysis used to create the chart are based on the author's own research. It reflects the author's categorization and interpretation of the literature reviewed.

IV. METHODOLOGY

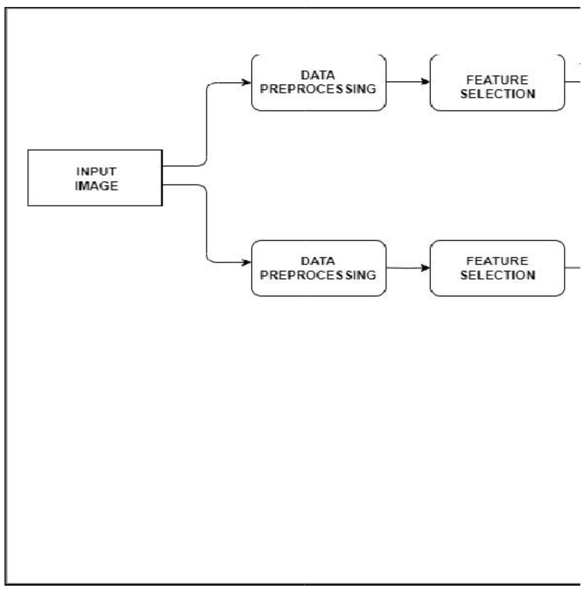

Fig : Block Diagram of Proposed System

The proposed system for Innovations in Stroke Identification involves the implementation of a machine learning-based diagnostic model using neuroimages. Utilizing algorithms such as Inception V3, MobileNet, and convolutional neural networks (CNN), the model aims to accurately detect and classify strokes based on MRI or CT scan images of the brain. Inception V3 is known for its deep architecture, which allows for better feature extraction and classification. MobileNet is efficient, making it suitable for resource-constrained environments like mobile devices. The CNN algorithm is specifically designed for image analysis tasks, enabling the model to identify patterns and features that may indicate a stroke condition in neuroimages. By leveraging these advanced algorithms in combination with a large dataset of labeled images, the system has the potential to significantly improve early detection and diagnosis of strokes, leading to better patient outcomes and treatment strategies. The performance of these models was evaluated using metrics like accuracy, precision, recall, and the area under the receiver operating characteristic curve (AUC-ROC). Cross-validation was employed to ensure the models' generalizability and to avoid overfitting. Hyperparameter tuning was conducted to optimize the models' performance. The CNN model likely required extensive training on powerful GPUs due to its deep architecture and the large volume of data. Comparative analysis was performed to determine which model provided the most accurate and reliable stroke diagnosis. The CNN, with its superior ability to capture spatial patterns in images, was expected to outperform the traditional machine learning models, although each method provided valuable insights into the diagnostic process. Ultimately, this multi-algorithmic approach facilitated a robust and comprehensive diagnostic tool for stroke identification, combining the strengths of both traditional and deep learning models.

V. LIMITATIONS OF REVIEW

The review of neuroimage-based stroke identification using a machine learning approach faces several limitations that may impact its efficacy and generalizability. Firstly, the heterogeneity in stroke types and imaging modalities can lead to inconsistencies in data interpretation and model training, potentially affecting diagnostic accuracy. Many studies may suffer from small sample sizes, which limits the statistical power and robustness of the findings. The reliance on specific algorithms and features may also result in overfitting, reducing the model's performance when applied to external datasets. Variations in imaging protocols and the absence of standardized assessment criteria can complicate comparisons across studies. Lastly, ethical considerations regarding data privacy and the interpretability of machine learning models remain significant challenges in clinical applications.

VI. CONCLUSION

In conclusion, the innovations in stroke identification using machine learning-based diagnostic models that incorporate neuroimages and algorithms such as Inception V3, MobileNet, and CNN have the potential to transform the way we diagnose and treat stroke. By leveraging the strengths of these algorithms, clinicians can rapidly and accurately identify patients with stroke, enabling timely treatment and improved patient outcomes. Furthermore, these models can help reduce the risk of misdiagnosis and improve patient flow in emergency departments. As these technologies continue to evolve, they are likely to have a profound impact on public health, reducing the incidence and severity of stroke and improving quality of life for millions of people worldwide. With continued investment in research and development, we can expect to see even more innovative applications of machine learning in stroke diagnosis and treatment, ultimately leading to better patient care and improved healthcare outcomes.

REFERENCES

[1]. Muhammad Asim Saleem, Ashir Javeed, Wasan Akarathanawat,"Innovations in Stroke Identification: A Machine Learning-Based Diagnostic Model Using Neuroimages",Received 13 February 2024, accepted 19 February 2024, date of publication 26 February 2024, date of current version 12 March 2024.Digital Object Identifier 10.1109/ACCESS.2024.3369673

[2]. L. Ali, A. Javeed, A. Noor, H. T. Rauf, S. Kadry, and A. H. Gandomi, ''Parkinson's disease detection based on features refinement through L1 regularized SVM and deep neural network,'' Sci. Rep., vol. 14, no. 1, p. 1333, Jan. 2024.

[3]. A Javeed, P. Anderberg, A. N. Ghazi, A. Noor, S. Elmståhl, and J. S. Berglund, ''Breaking barriers: A statistical and machine learningbased hybrid system for predicting dementia,'' Frontiers Bioeng. Biotechnol., vol. 11, Jan. 2024, Art. no. 1336255.

[4]. Javeed, J. S. Berglund, A. L. Dallora, M. A. Saleem, and P. Anderberg, ''Predictive power of XGBoost_BiLSTM model: A machine-learning approach for accurate sleep apnea detection using electronic health data,'' Int. J. Comput. Intell. Syst., vol. 16, no. 1, p. 188, Nov. 2023.

[5]. Javeed, A. L. Dallora, J. S. Berglund, A. Ali, P. Anderberg, and L. Ali, ''Predicting dementia risk factors based on feature selection and neural networks,'' Comput., Mater. Continua, vol. 75, no. 2, pp. 2491–2508, 2023.

[6]. E. Rasool, M. J. Anwar, B. Shaker, M. H. Hashmi, K. U. Rehman, and Y. Seed, ''Breast microcalcification detection in digital mammograms using deep transfer learning approaches,'' in Proc. 9th Int. Conf. Comput. Data Eng., Jan. 2023, pp. 58–65.

[7]. A Tursynova, B. Omarov, N. Tukenova, I. Salgozha, O. Khaaval, R. Ramazanov, and B. Ospanov, ''Deep learning-enabled brain stroke classification on computed tomography mages,'' Comput., Mater. Continua, vol. 75, no. 1, pp. 1431–1446, 2023.

[8]. M. Gupta, P. Meghana, K. H. Reddy, and P. Supraja, ''Predicting brain stroke using IoT-enabled deep learning and machine learning: Advancing sustainable healthcare,'' in Proc. Int. Conf. Sustain. Develop. Mach. Learn., AI IoT. Cham, Switzerland: Springer, 2023, pp. 113–122.

[9]. L. Cortés-Ferre, M. A. Gutiérrez-Naranjo, J. J. Egea-Guerrero, S. Pérez-Sánchez, and M. Balcerzyk, ''Deep learning applied to intracranial hemorrhage detection,'' J. Imag., vol. 9, no. 2, p. 37, Feb. 2023.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 2, November 2024

[10]. A Javeed, L. Ali, A. M. Seid, A. Ali, D. Khan, and Y. Imrana, ‘‘A clinical decision support system (CDSS) for unbiased prediction of caesarean section based on features extraction and optimized classification,’’ Comput. Intell. Neurosci., vol. 2022, pp. 1–13, Jun. 2022.

[11]. R. Noori, B. Ghiasi, S. Salehi, M. Esmaeili Bidhendi, A. Raeisi, S. Partani, R. Meysami, M. Mahdian, M. Hosseinzadeh, and S. Abolfathi, ‘‘An efficient data driven-based model for prediction of the total sediment load in rivers,’’ Hydrology, vol. 9, no. 2, p. 36, Feb. 2022.

[12]. J. Donnelly, S. Abolfathi, J. Pearson, O. Chatrabgoun, and A. Daneshkhah, ‘‘Gaussian process emulation of spatio-temporal outputs of a 2D inland flood model,’’ Water Res., vol. 225, Oct. 2022, Art. no. 119100.

[13]. S. A. Mostafa, D. S. Elzanfaly and A. E. Yakoub, "A machine learning ensemble classifier for prediction of Brain Strokes", International Journal of Advanced Computer Science and Applications, vol. 13, no. 12, pp. 258-266, 2022.

[14]. S. Gupta and S. Raheja, "Stroke prediction using machine learning methods", 2022 12th International Conference on Cloud Computing Data Science & Engineering (Confluence), pp. 553-558, Jan. 2022.

[15]. H. Al-Zubaidi, M. Dweik and A. Al-Mousa, "Stroke prediction using machine learning classification methods", 2022 International Arab Conference on Information Technology (ACIT), pp. 1-8, Nov. 2022.

[16]. S. Dev, H. Wang, C. S. Nwosu, N. Jain, B. Veeravalli and D. John, "A predictive analytics approach for stroke prediction using machine learning and Neural Networks", Healthcare Analytics, vol. 2, pp. 1-9, Nov. 2022.

[17]. Sharma, S. Sharma, M. Kumar and A. Sodhi, "Early stroke prediction using machine learning", 2022 International Conference on Decision Aid Sciences and Applications (DASA), pp. 890-894, Mar. 2022.

[18]. T. Tazin, M. N. Alam, N. N. Dola, M. S. Bari, S. Bourouis and M. Monirujjaman Khan, "Stroke disease detection and prediction using robust learning approaches", Journal of Healthcare Engineering, vol. 2021, pp. 1-12, Nov. 2021.

[19]. H. K V, H. P. G. Gupta, V. P and P. K B, "Stroke prediction using machine learning algorithms", International Journal of Innovative Research in Engineering & Management, vol. 8, no. 4, pp. 6-9, 2021.

[20]. Jeyaraj Durai Pandian and Ivy Anne Sebastian, "Integrated approach to stroke burden: are we doing enough?", The Lancet Neurology, vol. 20, pp. 774-775, October 2021.

[21]. T.S.Porje, Pagar Vinayak ,Raikar Ankit ,Sinkar Dipeeka ,Prof. N.R.Wankhade.”Avoid Cataract: Machine Learning Based Approach for Diagnosis of Eye” Journal JETIR vol. 8 ,pp 2349-5162 ,June 2021