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Human Critical Organ Disease prediction using Deep Learning

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Abstract - **Deep learning techniques have transformed medical science by enabling the early prediction of serious organ disorders in humans, such as those affecting the heart, brain, and kidneys. This paper presents a thorough investigation into disease prediction using Convolutional Neural Networks (CNNs) alongside machine learning algorithms. Key challenges including model overfitting, interpretability limitations, imbalanced datasets, and data scarcity are examined. The study underscores the importance of transparent and interpretable models in medical decision-making, advocating for the development of explainable AI methods tailored to healthcare needs.**

The research demonstrates promising performance in accuracy, sensitivity, and specificity, showcasing the potential of deep learning in enhancing the diagnosis and prognosis of critical organ diseases. By addressing these challenges, the proposed framework offers a robust and effective approach to disease prediction, contributing to the advancement of medical diagnostics. This approach holds the promise of revolutionizing healthcare by facilitating early intervention and personalized treatment strategies for patients with critical organ diseases.

Index Terms— Deep Leaning, CNN, Image Processing, Disease Prediction, Model integration

INTRODUCTION

Human Critical Organ Disease prediction using Deep Learning is a cutting-edge approach to healthcare that leverages advanced artificial intelligence techniques to forecast the onset or progression of severe organ-related conditions. This innovative method holds promise for early diagnosis, tailored care, and improved patient outcomes. Deep learning algorithms, a form of machine learning, analyse vast amounts of data to detect intricate patterns, particularly valuable in diagnosing serious organ disorders like liver cirrhosis, kidney disease, or heart failure. By scrutinizing genetic profiles, imaging scans, and medical records, these algorithms construct prediction models, offering clinician's crucial insights into a patient's risk factors and potential disease progression. Early identification of high-risk patients enables swift intervention, potentially averting complications or irreversible organ damage. Deep learning models can be continually refined with new data, ensuring their predictive accuracy and adaptability in therapeutic decision-making scenarios. Despite its potential, integrating deep learning into healthcare faces challenges such as addressing biases in training data, safeguarding data privacy, and ensuring clinical relevance in model outputs. Nonetheless, deep learning-based prediction of critical organ diseases heralds a transformative era in healthcare, promising more precise, timely treatments that enhance patient outcomes and quality of life as research progresses.

PROPOSED WORK

Study focuses on using deep learning, a type of artificial intelligence, to predict diseases in critical human organs such as the heart, kidneys, and brain. Deep learning algorithms will analyse medical images to detect early signs of diseases like heart conditions, kidney disorders, and neurological issues. The research will involve training the deep learning model on a large dataset of medical images and using validation techniques to ensure its accuracy. In this paper the machine learning algorithm random forest and deep learning algorithm CNN is used for disease prediction.

METHODOLOGY

1. Data Collection:

On predicting diseases of critical human organs like the heart, brain, and kidney using deep learning, we're focusing on collecting diverse types of data. For heart disease prediction, we're gathering structured data, including age, sex, treetbps, cholesterol, blood sugar, etc. The structural dataset is collected from Kaggle. The dataset contains 1000+ values and 13 attributes. Cleansing and pre-processing of data is done by handling missing values, removing null values, standardizing features, and ensuring compatibility across datasets. On the other hand, for brain and kidney disease prediction, we collect image data such as MRI scans and ultrasound images from the internet, and pre-processing of image data is done by Resize Images Using Rescaling and Cropping, converting them into greyscale, removing unwanted photos, etc. both kidney and brain disease datasets include 75% training and 25% testing images.

2. Model Development:

In our research, we used different types of Convolutional Neural Networks (CNNs) to classify Alzheimer's disease (AD) and kidney disease. CNN is a type of neural network that is good at understanding grid-like data, such as images. An image, when digitalized, is a grid of pixels, each with a brightness and colour value. CNNs are very effective at recognizing patterns in images, which makes them great for tasks like image recognition.

Unlike traditional neural networks, where every node is connected to the other node in the next layer, CNNs use a more efficient approach.

They connect nodes that are relevant based on the image's structure, which makes them better at handling image data.

Convolutional Neural Network:

CNN includes Convolutional Layers, Pooling Layers, Activation Functions, and Fully Connected Layers. For our proposed research, we used three Convolutional Layers and Max-pooling layers using the ReLU activation function. The ReLU activation function is used to introduce nonlinearity in a neural network, helping mitigate the vanishing gradient problem & in Fully Connected Layers flattened and dense layers are used using the activation function sigmoid. The main use case of the sigmoid function is the activation function for the output layer of binary classification models in the compilation of a model for a loss function binary_crossentropy, a loss function is used to measure how well the CNN is performing on the training data. And an optimizer is employed to adjust the weights. Here Adm optimizer is used.

The performance of a CNN in image categorization tasks can be assessed using various criteria. Among the most popular metrics is accuracy, precision, recall, f1 score, etc.

Random Forest Classifier:

We have used a random forest classifier for predicting the chances of heart disease. Random Forest operates by creating numerous decision trees during the training phase. Each tree is trained independently on a random subset of the training data and a random subset of the features. During prediction, each tree individually classifies the input data, and the final prediction is determined by a majority vote among all the trees for classification tasks.

This ensemble approach reduces overfitting, increases robustness, and improves generalization performance. Random Forests are useful due to their ability to handle high-dimensional data, handle missing values, and provide an understanding of feature importance. They are widely used in classification and regression tasks

3. Website Development:

Frontend Design: Design an intuitive user interface for the website, allowing users to input medical data and receive disease predictions. Backend Development: Develop the backend infrastructure to handle user requests, process data inputs, and interact with the deep learning models.

Database Integration: Integrate a database system to store user data securely and facilitate seamless retrieval for analysis. Real-Time Prediction: Implement mechanisms for real-time disease prediction based on user inputs.

4. Evaluation and Validation:

Performance Metrics: Evaluate model performance using accuracy, precision, recall, and F1-score metrics. Cross-Validation: Employ cross-validation techniques to assess model generalizability and robustness. User Testing: Conduct user testing to gather feedback on website usability, functionality, and performance.

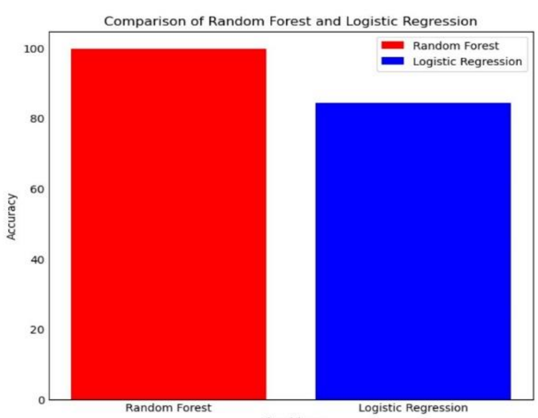
5. Deployment and Maintenance:

Website Deployment: Deploy the integrated website and models on a secure server accessible to users. Continuous Monitoring: Implement mechanisms for monitoring model performance and website functionality, addressing any issues promptly.

Updates and Enhancements: Regularly update the website with new features, improvements, and enhancements based on user feedback and advancements in deep learning research.

6. Result and Analysis:

For heart disease prediction we trained two for heart disease prediction we trained two models using the CSV dataset logistic regression and Random Forest classifier. The random forest classifier demonstrated robust performance by accurately predicting the likelihood of heart disease occurrence. Its strength lies in its ability



To handle complex datasets and capture intricate relationships between various factors such as age, cholesterol levels, and blood pressure. On the other hand, logistic regression, known for its simplicity and interpretability, provided valuable insights into the importance of individual predictors in determining the risk of heart disease. The logistic regression gives an accuracy of 100% and the random forest classifier gives an accuracy of 84%. Since the accuracy of the random forest classifier is higher, we choose it as the final model for heart disease prediction.

For brain and kidney disease prediction we trained a model using the CNN algorithm as the data available was in the form of images.

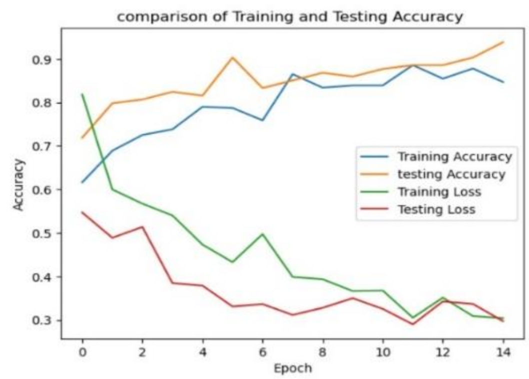


Fig. Accuracy Graph of Brain disease Prediction

We used the Convolutional layer and max pooling three times for feature extraction. For these layers we used ReLU. The ReLU (Rectified Linear Unit) activation function is a simple and widely used function in neural networks. It returns 0 for negative and 1 for positive inputs.

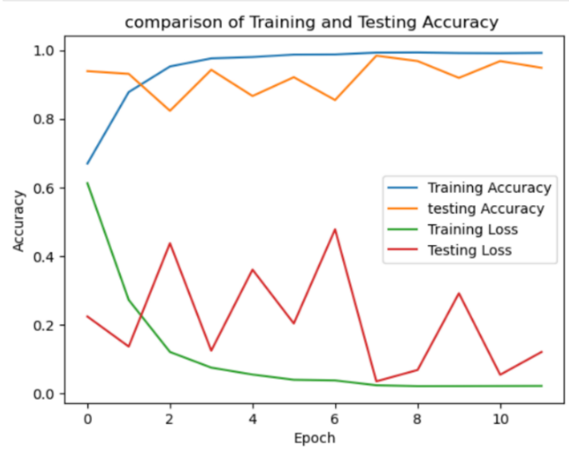


Fig. Accuracy Graph of Kidney disease Prediction

Then we used dense and flattened layers for connecting the max pooling layer to the output layer, in the dense layer we used the sigmoid function which is a mathematical function that results from the output between 0 and 1.

In brain disease prediction we used 15 epochs to train the data. After successfully creating the model, we got an accuracy of 93%, and for kidney disease prediction we used 12 numbers of epochs which gives an accuracy of 97%.

CONCLUSION

In conclusion, this research paper has explored the pivotal role of deep learning techniques in predicting critical human organ diseases, specifically focusing on the heart, brain, and kidneys. We've seen that using deep learning, which involves computers learning from lots of data, can change how we spot and treat diseases early. By analysing a ton of medical information like scans and patient records, these models can accurately predict the outcomes of organ-related illnesses. The utilization of Convolutional Neural Networks (CNN) for kidney and brain disease prediction, alongside the Random Forest Classifier for heart disease, demonstrates promising strides in early detection. Despite these challenges, ongoing research and development in deep learning offer transformative possibilities in revolutionizing disease prediction and healthcare management, promising improved health outcomes globally. Overall, the research presented underscores the transformative potential of deep learning revolutionizing disease prediction and healthcare delivery.

REFERENCES

[1] P. S. Nishant, B. G. K. Mohan, S. Mehrotra, R. Devathi, P. Sowmya and P. Srikanth, "Maize grading system using Deep learning and flask application," 2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS), Coimbatore, India, 2022, pp. 498-503, doi: 10.1109/ICAIS53314.2022.9743124.

[2] A. Lakshmanarao, M. R. Babu, C. Gupta and A. S. G. Lakshmi, "Stock Price Prediction using Deep Learning and FLASK," 2022 International Conference on Innovative Computing, Intelligent Communication and Smart Electrical Systems (ICSES), Chennai, India, 2022, pp. 1-5, doi: 10.1109/ICSES55317.2022.9914347.

[3] A. Verma, C. Kapoor, A. Sharma and B. Mishra, "Web Application Implementation with Machine Learning," 2021 2nd International Conference on Intelligent Engineering and Management (ICIEM), London, United Kingdom, 2021, pp. 423-428, doi: 10.1109/ICIEM51511.2021.9445368.

[4] P. Chittora et al., "Prediction of Chronic Kidney Disease - A Machine Learning Perspective," in IEEE Access, vol. 9, pp. 17312-17334, 2021, doi: 10.1109/ACCESS.2021.3053763.

[5] F. Arafat, T. Khan, A. D. Bapon, M. I. Khan and S. R. H. Noori, "A Deep Learning Approach to Predict Chronic Kidney Disease in Human," 2021 IEEE 12th Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON), Vancouver, BC, Canada, 2021, pp. 1010-1015, doi: 10.1109/IEMCON53756.2021.9623101.

[6] P. Khan et al., "Machine Learning and Deep Learning Approaches for Brain Disease Diagnosis: Principles and Recent Advances," in IEEE Access, vol. 9, pp. 37622-37655, 2021, doi: 10.1109/ACCESS.2021.3062484.

[7] P. Praveen, K. Srilatha, M. Sathvika, E. Nishitha and M. Nikhil, "Prediction of Alzheimer's Disease using Deep Learning Algorithms," 2023 2nd International Conference on Applied Artificial Intelligence and Computing (ICAAIC), Salem, India, 2023, pp. 587-594, doi: 10.1109/ICAAIC56838.2023.10140746.

[8] J. K. Jaiswal and R. Samikannu, "Application of Random Forest Algorithm on Feature Subset Selection and Classification and Regression," 2017 World Congress on Computing and Communication Technologies (WCCCT), Tiruchirappalli, India, 2017, pp. 65-68, doi: 10.1109/WCCCT.2016.25.

[9] Alzubaidi, L., Zhang, J., Humaidi, A.J., Al-Dujaili, A., Duan, Y., Al-Shamma, O., Santamaría, J., Fadhel, M.A., Al-Amidie, M. and Farhan, L., 2021. Review of deep learning: Concepts, CNN architectures, challenges, applications, future directions. Journal of big Data, 8, pp.1-74.

[10] G. Chen et al., "Prediction of Chronic Kidney Disease Using Adaptive Hybridized Deep Convolutional Neural Network on the Internet of Medical Things Platform," in IEEE Access, vol. 8, pp. 100497-100508, 2020, doi: 10.1109/ACCESS.2020.2995310.

[11] A. A. Ali, H. S. Hassan and E. M. Anwar, "Heart Diseases Diagnosis based on a Novel Convolution Neural Network and Gate Recurrent Unit Technique," 2020 12th International Conference on Electrical Engineering (ICEENG), Cairo, Egypt, 2020, pp. 145-150, doi: 10.1109/ICEENG45378.2020.9171739.

[12] M. T. Abed, U. Fatema, S. A. Nabil, M. A. Alam and M. T. Reza, "Alzheimer's Disease Prediction Using Convolutional Neural Network Models Leveraging Pre-existing Architecture and Transfer Learning," 2020 Joint 9th International Conference on Informatics, Electronics & Vision (ICIEV) and 2020 4th International Conference on Imaging, Vision & Pattern Recognition (icIVPR), Kitakyushu, Japan, 2020, pp. 1-6, doi: 10.1109/ICIEVicIVPR48672.2020.9306649.