JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Cardio Vascular Disease Risk Prediction Using Retinopathy

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Abstract-- ***The "Predicting Cardio-vascular Disease Using Retinopathy" project presents a novel approach to cardiovascular health assessment using cutting-edge image analysis methods. This method looks at retinal images (pictures of the back of the eye) to find possible signs of heart attack risk. Heart disease remains a leading cause of illness and death worldwide. Timely detection and evaluation of cardiovascular disease risk are crucial for effective prevention and timely intervention This study looks at how deep learning methods are used to predict cardiovascular risk (CVR) by analyzing retinal images. Since the retina is part of the central nervous system, it offers a unique way to diagnose health conditions safely. Combining different types of retinal images with patient and medical data created a new deep-learning model to predict important health factors linked to heart disease. Using a type of deep learning called CNN, the model can automatically detect useful information from retinal images without manual work. The main goal of this study is to predict conditions like high blood pressure, diabetes, and high cholesterol, which are risk factors for heart disease. Our deep learning model achieves incredible accuracy in identifying high-individuals by detecting alterations in retinal blood vessels, microaneurysms, and other indicators of pathology. Additionally, the model provides good information about the relationship between the clarity of retinal images and the seriousness of these conditions. We also look at ways to explain how the prediction models work, helping us understand how changes in the retina are connected to heart disease risk through the body's disease processes. Such research can guide doctors in enhancing their clinical practices and enable earlier interventions to help prevent this health condition.***

Keywords— **Retinal Eye Images, Cardiovascular Health, Machine Learning, Deep Learning, Federated Learning, Image Processing, Predictive Modelling, Healthcare Analytics, Cardiovascular Health.**

I. INTRODUCTION

Cardiovascular diseases (CVD) are some of the most critical health conditions, warranting early detection and intervention to prevent severe complications. If left unaddressed, these diseases can significantly increase the risk of heart attacks and other life-threatening cardiac events. Timely diagnosis and management are essential to reduce their impact and improve patient outcomes. Cardiovascular diseases(CVD) are primarily caused by disorders affecting the heart and blood vessels. There are also various other risk factors, including hypertension, obesity, and smoking contributing to the increased cases of Cardiovascular disease. In previous days the model is developed for predicting the disease and risk of cardiovascular disease (CVD) using the various types of risk calculators like pooled Cohort Equation Systemic Coronary Risk Evolution and many more. These models have the lack of validation and accuracy.

Cardiovascular diseases are a leading cause of death worldwide. As we know there is a new concept by which we can detect diabetes using retinal eye images which is retinopathy. By combining retinopathy and the image processing concept in Machine learning and Deep learning researchers build a model for detecting diabetes by Machine learning. By referring to these models we can also find the risk of cardiovascular diseases. Some cardiovascular diseases (CVD) affect on our retina. Such as the yellow-white spot on the retina which is caused by hypertension and leads to heart attack, we can also detect certain changes in the size and shape of the vessels and also the changes in the macula which can lead to reducing the eye slightly, factors like increased stress and unhealthy eating habits, including high cholesterol levels in foods, have contributed to rising cholesterol levels. This leads to blood clots in vessels, increasing the risk of heart attacks. However, these types of diseases can be detected in the early stage by using retinopathy. The retina provides early signs of small changes in the body. If we detect the disease in an early stage then we can start the treatment of the patient and risk of the heart attack or any major disease can be prevented.

The primary objective of the research is to detect and predict the risk of cardiovascular diseases using retinopathy and developing a deep learning model. To predict the risk we can use THE COLOUR FUNDS PHOTOGRAPH. By using the various deep learning algorithms we can build this model. In this research, we use the rich dataset and the neural network model (CNN) to predict disease. In most of the studies, retinal microvascular due to microaneurysms, retinal hemorrhages and vascular changes may indicate the presence of line disease in the body, including high blood pressure, diabetes, and various heart diseases.

II. LITERATURE SURVEY

1. Enhancing stability in cardiovascular disease risk prediction: (2023)

In this research, the Reti-WHO scores, demonstrated enhanced stability compared to WHO CVD scores calculated solely from the patient's physical indicators, suggesting that the features learned from retinal fundus photographs serve as robust indicators of CVD risk. However, the model may still exhibit false negatives in high-risk predictions, requiring ongoing research for refinement. Future directions involve validating the model across diverse populations and exploring multi-image and multi-modal approaches to enhance prediction accuracy. Additionally, integrating advanced machine learning techniques could improve the model's ability to discern subtle patterns in retinal images that correlate with cardiovascular health. Emphasizing collaboration with clinical practitioners may facilitate real-world implementation, ensuring that the Reti-WHO scores can effectively contribute to early detection and preventative strategies in cardiovascular care.

2. Heart Disease Prediction Using Eye Retinal Images (2023):

In this research, they have embarked on a large-scale study using retinal images and patient characteristics such as age, blood pressure, hemoglobin levels, and body weight to predict cardiovascular disease. Their goal is to provide a reliable and accurate tool for early diagnosis of severe heart attacks. The results of their work were excellent; their model achieved an accuracy of 98.9%. These advances demonstrate the feasibility of deep learning techniques, including neural networks (RNN) and fuzzy C-means (FCM). The integration of retinal imaging with patient data not only enhances predictive power but also highlights the potential for non-invasive diagnostics in cardiovascular health. Future work may focus on refining the model to reduce false positives and exploring its application in diverse clinical settings to ensure its broad utility.

3. Prediction of Cardiovascular Diseases with Retinal Images Using Deep Learning (2024):

The paper presents a method for predicting cardiovascular diseases (CVDs) through the analysis of retinal images using deep learning techniques. The study employs convolutional neural networks (CNNs) integrated with MobileNet architecture to create an efficient and accurate prediction model. Retinal images are chosen as a non-invasive diagnostic tool due to their correlation with vascular health, making them an effective indicator of CVD risk.

The proposed system processes retinal images by collecting, preprocessing, and augmenting the data to enhance model robustness. The CNN model, optimized using the MobileNet framework, handles the classification of retinal images into categories based on the presence of CVD. Key steps include image preprocessing, training using algorithms like stochastic gradient descent (SGD) or Adam, and fine-tuning the model to prevent overfitting.

Evaluation metrics such as accuracy, sensitivity, and specificity are used to assess model performance. The model shows promise in the early detection of CVD, achieving high training accuracy, though further efforts are required to enhance validation accuracy and reduce overfitting. The study concludes that integrating retinal imaging and deep learning could offer a cost-effective and non-invasive method for predicting CVDs, improving patient outcomes, and reducing complications.

4. Predicting the Risk of Heart Attack Using Retinal Eye Image Analysis (2024):

The paper explores a novel method for early heart disease detection using retinal images. Cardiovascular diseases (CVDs) are the leading cause of death worldwide, and early diagnosis is crucial. The study leverages retinal image analysis, as retinal vascular structures have similarities with cardiovascular systems, making them useful for identifying potential heart conditions.

The authors propose using Recurrent Neural Networks (RNNs) to process sequential retinal image data. RNNs are suited for detecting patterns in time-dependent data, making them ideal for this application. The methodology involves collecting retinal images, preprocessing them to maintain consistency, developing an RNN model to predict heart disease risk, and testing the model's accuracy. The ultimate goal is to create a non-invasive, cost-effective diagnostic tool that can predict heart disease through retinal images, potentially improving early intervention and saving lives.

5. Heart Attack risk prediction using retinal eye images

This project represents a significant advancement in cardiovascular health assessment. By harnessing the power of retinal imaging and advanced machine learning techniques, this project offers a non-invasive and accessible method for early risk prediction of heart attacks. The system's ability to correlate retinal features with cardiovascular health indicators provides a more comprehensive and accurate assessment. This approach has the potential to revolutionize preventive healthcare by identifying individuals at risk of heart attacks at an early stage, enabling timely interventions and potentially saving lives. It addresses the limitations of traditional risk assessments and offers a more inclusive and cost-effective solution.

III. METHODOLOGY

A. Model performance

Assessing the model's performance is a crucial aspect of our research. The evaluation includes the following metrics:

Validation Accuracy**:** Regularly monitor the model's accuracy throughout the training process to confirm its ability to generalize effectively to new, unseen data.

Test Accuracy: Utilize an independent test dataset, which was not involved in the training phase, to measure the model's overall accuracy and its applicability in real-world scenarios.

B. Data Collection and preprocessing

Selection process: In this process, we can select diverse and relevant data. The selected data contains the 1000 funds images which are classified with their categories.

Data cleaning and preprocessing: We can use only the data that is required to build the model and we shortlist them.

We also perform the data augmentation and segmentation on the selected images and prepare them for the model building. Each image in the data should be labeled with its proper category.

C. Model selection

We use transfer learning and CNN this model is used collaboratively to give consistence and valid output. CNN was utilized due to its strength in image classification tasks. The model comprises several convolution layers for feature extraction, pooling layers to reduce dimensionality, and a dense layer for classification.

D. Result and Discussion

The model was evaluated using metrics like accuracy, sensitivity, specificity, and AUC-ROC. The CNN Model demonstrated strong performance, with an accuracy and AUC-ROC score. Interpretability techniques provided insight into the model's decision-making, enhancing trustworthiness and applicability in clinical settings. Challenges included managing computational resources and ensuring data quality, especially in federated learning.

IV. FUTURE SCOPE

There are many openings for future improvement. Future developments can incorporate not only medical images but also electronic well-being records, hereditary information, lab results, and way-of-life variables. Endeavors to make profound learning will offer assistance to clinicians get why certain forecasts are made. Methods such as review- CAM or SHAP can be utilized to visualize which parts of a picture or deny in the information contributed most to the expectation. By recognizing at chance people early, these models can illuminate the focus on preventive such as way-of-life changes, medicine, or more visit monitoring. Federated Learning can be utilized to prepare show on quiet information from different clinics and districts without sharing delicate data. Such conveyed models would be able to learn from worldwide datasets while keeping nearby persistent information secure. Future shows seem to execute proceeds learning systems that upgrade their weights and progress precision as more understanding information is collected. This is especially imperative for energetic maladies like CVD, where hazard components advance over time. Improved models can identify cardiovascular chance in asymptomatic patients at prior arrange, possibly driving to preventative mediations some time recently any clinical indications shows up. We can moreover make the crossover demonstrate in the future or we too utilize the robotized machine learning apparatuses and NAS can be utilized to optimize the design of profound learning models, possibly driving to more proficient and compelling cardiovascular hazard forecast models.

V. CONCLUSIONS

In this, we can use deep learning, machine learning algorithms, and models that hold transformative potential for cardiovascular disease risk prediction and also enhance early detection. This model is 90% accurate and it gives remarkable output. This is a clinical software for early detection of disease. This model is deployed through the web using Django. Looking forward we enhance this model and also integrate this with multi-model data. We can also make it federated in the upcoming time. By making it federated it will give us the feasible and remarkable output from the system. This will also help full to work with more datasets and on real data or we say working on live data. This technology continuously evolves and increases real-time prediction quality. We also make it personalized for the user. Ultimately this model will be a very useful tool in the medical field.

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