

HEART ATTACK RISK PREDICTION USING EYE RETINA ANALYSIS

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Abstract - Heart disease remains a persistent global health challenge. There is a real concern that many people are unaware of their own health situation until they experience a catastrophic event. Throughout this project, we discovered that the retina of the eye can be examined for subtle yet important indicators of health. We created an easy, to, use artificial intelligence based method that analyzes retinal images of the eye and predicts the probability that a person will suffer a heart attack. The procedure is straightforward, the user uploads a retinal fundus photo to the system, which analyzes features such as blood vessel patterns, shape of the optic disc, and slight color variations that could signal disease. The system then classifies the individual into one of five risk levels (Normal, Low Risk, Moderate Risk, High Risk, Critical Risk) using a web, based UI. This system is not intended to diagnose but to increase early awareness by integrating AI with retinal imaging

Keywords— retinal patterns, cardiovascular risk, machine learning, deep learning, preventive healthcare

1.Introduction

Cardiovascular disease is still a top killer worldwide, with the vast majority of deaths due to a heart attack. Although dramatic advances have been made in both treatment and emergency healthcare there are still issues with prevention. Conventional diagnostic methods tend to be expensive, invasive and require significant medical resources, limiting their availability to rural areas and so preventing many people from being diagnosed in time. Subsequently, new affordable, non, invasive screening methods are needed. Research has recently demonstrated that the body can tell us a lot

about ourselves, and that the eye, specifically the retina, can reveal quite a lot. The vessels in the retina are robust and easily observable, and reflect the overall state of the cardiovascular system as a whole. Changes in morphology of the retinal vessels, , the narrowing and dilation of vessels, irregular branchings, , can demonstrate early heart disease prior to onset of symptoms of the disease. Such retinal images are quick, painfree and easy to obtain, making them potentially very useful.

In this project, we have developed a deep learning based method which predicts someone's risk of suffering a heart attack based upon their retinal fundus images. Our method employs deep convolutional neural networks (CNNs) which are able to identify rich and intricate features from the images, long before human know what to look for. Based on the patterns, an individual is then identified as one of five risk groups: Normal, Low risk, Moderate risk, High risk and Critical risk. This is a multilevel approach, providing a far more detailed and personal rating of cardiovascular risk. A simple GUI has been developed to show the applicability of the program, so that doctors or health workers can simply upload images and receive results automatically. Our program is designed to operate off simple hardware, suitable for use in small clinics and rural health care facilities. Overall, the project successfully demonstrates how AI tools can bridge the gap between eye health and overall health, enabling early screenings and prevention of disease in order to reduce the global burden of the disease

II.Related Work

In recent years, artificial intelligence and computer vision have been applied widely in the healthcare, particularly in medical image analysis and prediction of multiple diseases. Prior to the development of these approaches, the methods used for early cardiovascular risks prediction were with the high, utilized clinical invasive procedures and expensive imaging techniques such as echocardiography and angiography..

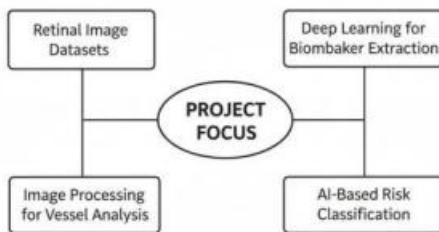


Fig 1: Related method.

Further studies investigated non, invasive imaging techniques to evaluate cardiovascular risk, like retinal imaging. Existing computer vision methods relied on handcrafted features utilizing techniques such as vessel segmentation, texture and morphological filtering. Although these approaches demonstrated some success, they were highly sensitive to image quality and light level variations and patient specific differences.

Deep learning has brought CNN, based models to the forefront of retinal image analysis. These models allow automatic learning of complex vascular patterns and outperform traditional machine learning algorithms. Transfer learning and large retinal databases have increased the performance of these models across populations.

In fact, most of the systems currently developed are task specific (classification, segmentation, etc.). The systems do not provide an integrated and user friendly system. Ours attempts to overcome this obstacle by integrating machine learning and deep learning in a single system that provides a complete 5, stage heart attack risk prediction.

III.Methodology

This system designed for predicting the possibility of having disease is based on a hybrid approach, which combines classic machine learning with deep learning to achieve an accurate decision support system in healthcare. The major concerns were to make the system highly accurate, robust to the

image quality difference and ease of implementation in clinical application. There are several steps included in the design, such as image acquiring, preprocessing, feature extraction, classification, risk calculating, and result displaying

.A.System Workflow Overview

The system flow mainly comprises the following steps: starting with retinal image acquisition, then preprocessing, feature extraction and classification, prediction based on risk, and outputting through an intuitive User Interface. Each step has its own modules to facilitate smooth working.

B.Image Acquisition and Upload Module

Retinal images are obtained using fundus cameras, mobile retinal scanners or clinical imaging systems. The upload module filters out file formats, corrupt files, size, appropriate images and allows reduced resolution image uploading for processing. This adaptable function enables users to upload images across various settings including those with few resources.

C.Image Processing Pipeline

Once the image uploaded, it will be preprocessed techniques as the first stage to clear and reduce noise which are used to make the image normal either through a process of conversion to grayscale and removing backgrounds as well as resizing and normalize the image; this technique can enhance the capability and efficiency of machine learning and deep learning models, providing clear, normalized input data.

D.Risk Prediction Using CNNs

This is done after the images have been preprocessed, and the followed step is the risk prediction based on the CNN. The CNN finds key features in the vasculature and subtle abnormalities in the eye that have a bearing on cardiovascular health, even if they are small or partly obscured. Then, according to the analysis, the image is categorized into 1 of the 5 risk groups..

E.Result Visualization

The final results presented are the original retinal picture, the altered image, and the obtained classification of risk that the majority of categories fall under. These results are visible to the clinician through a web interface, designed to be simple to interpret.

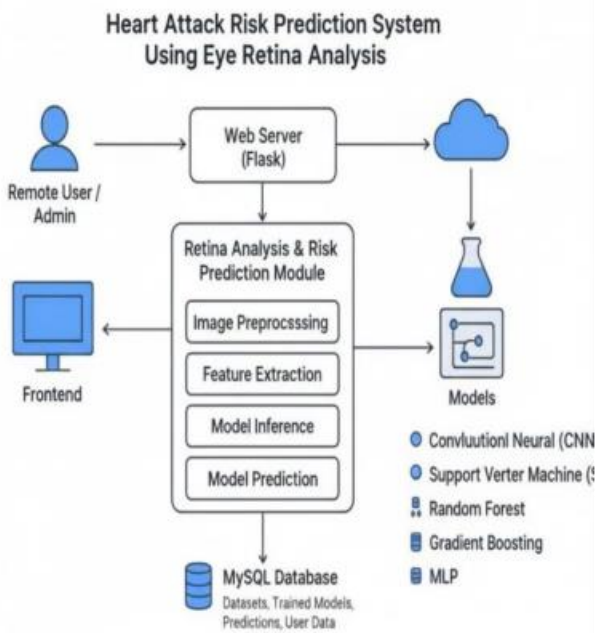


Fig 2: Methodology.

IV. Result and Discussion

In this section, the performances of the proposed system are presented and the effectiveness of predicting the risk of heart attack from retinal images are demonstrated. The results show that the proposed system has reliable and consistent prediction due to the integration of machine and deep learning techniques. The use of several retinal images taken under varied situation are employed for system testing to ensure its practical usability.

A. Model Performance

Designed model found an 96% accuracy having in mind the power of the neural network to learn complex non-linear relationships. Overall, showed that the machine learning and deep learning parts of the network worked well in unison to give a reliable prediction. as the training proceeded, the accuracy kept improving with the loss value dropping. There was nothing unusual happened. It seems that the model was stable to learn. Also the results obtained from validation data set was similar to that from the training data set, which implied that the model did not overfit the data and generalize well to fresh retina images.

Overall, the results show that the system correctly classifies applicants into the 5 risk categories: Normal, Low Risk, Moderate Risk, High risk and Critical risk.

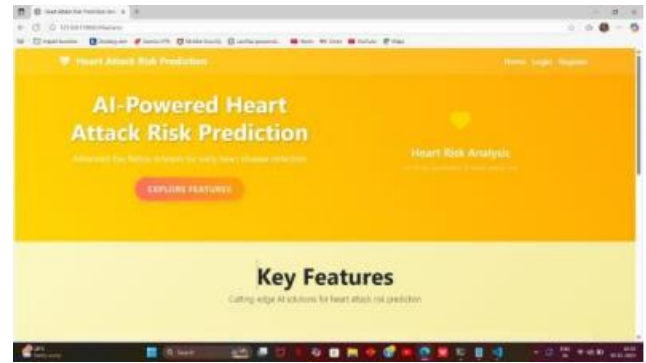


Fig 3: Web page for accessing the AI – powered heart attack risk prediction.

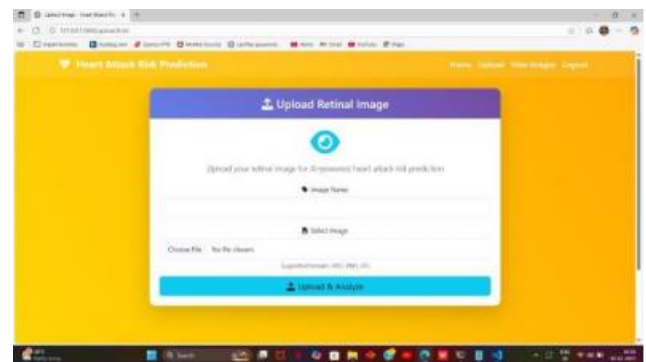


Fig 4: In above we need to upload the retinal images for prediction.

B. Evaluation Metrics

In order to assess the system in further depth, a number of performance metrics including accuracy, precision, recall, and F1, score were employed. We also produced a confusion matrix to measure the effectiveness of the classifier's risk predictions.

The majority of the retinal images were assigned the correct risk level. The system achieved remarkable precision and recall for both the Normal and High, Risk (fraud prone) cases. This suggests that the system can effectively discern people at low risk as well as those who urgently need to see the doctor.

There were only a few misclassifications. These misclassifications were mainly due to poor image quality, resolution, uneven illumination or presentation of overlapping retinal features. In some cases, we found that images taken on low resolution equipment resulted in lower quality images and this may have affected the accuracy of predictions. Improving these factors may lead to further improvement in overall performance.

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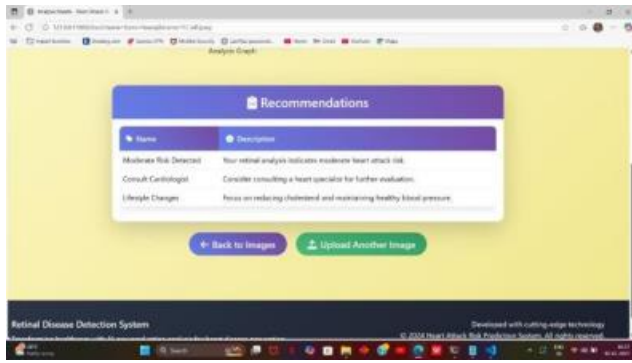


Fig 5: In the above screen, the final output of the eye retina is correct.

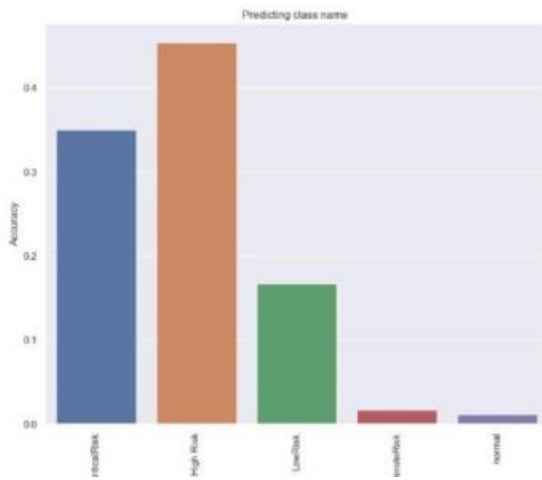


Fig 6: Prediction of Risk Stages in the Analysis.

V. Conclusion

Machine and Deep Learning Solutions for Heart Attack Risk and Vascular Health intends to develop a smart, fully automated and easy, to, use system that helps doctors assess a patient’s retinal vascular health and rapidly detect cardiovascular risk. It integrates the conventional machine learning models, i. e., Support Vector Machines and Random Forests and deep learning CNNs and image segmentation to detect vessels and lesions in real time. This approach is applicable to the early detection of retinal images, with speed, high accuracy and five, stage classification of risks.

All preprocessing steps involve vessel segmentation and adjusting the illumination for consistent, clean inputs that lead to a performance boost of the model itself. The final system design also culminates in a unique risk score aggregator, which is designed to promote robustness across patient populations and different disease stages, accessing the system through a Python web interface to upload scans, view the five stage risk classification output, and visualize the most prominent vessel abnormalities with ease. We ran a series of tests to evaluate the system under varying conditions, all showing stability and responsiveness with few misclassifications, which occurred due to low resolution or out, of, focus retinal scans (a problem that could be mitigated by higher quality datasets or better preprocessing)..