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"Heart Attack Risk Prediction Using Retinal Eye Images Based On Machine Learning And Image Processing"

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Abstract: Heart disease increases the mortality rate in recent years across the world. So, it is necessary to develop a model to predict heart disease occurrence as early as possible with a higher rate of accuracy. Till now the detections are gone through blood tests, ECGs, and invasive stress tests. In this project, heart disease is predicted by a non-invasive method with the retinal image data. A Chase image dataset is considered, as the health of our eyes is connected to the health of our heart. Here, Heart problems can be detected from the changes in the microvasculature, which is imaged from the retina. The prediction of disease is by considering features like the size of blood vessels, non-uniform background illumination, etc. We use Image processing for identifying patterns in images and the Support Vector Machine (SVM) and Random Forest Classifier (RFC) algorithm for classification. The main objective of the proposed system is to predict the occurrence of heart disease from retinal fundus images with a higher rate of accuracy.
Keywords: Image processing, Heart disease, Retina, Microvasculature, SVM, RFC.

I. INTRODUCTION

Risk stratification is central to identifying and managing groups at risk for cardiovascular disease, which remains the leading cause of death globally. Although the availability of cardiovascular disease risk calculators, such as the Pooled Cohort equations , Framingham and Systematic Coronary Risk Evaluation (SCORE), is widespread, there are many efforts to improve risk predictions[1]. Phenotypic information, particularly of vascular health, may further refine or reclassify risk prediction on an individual basis. Coronary artery calcium is one such example, for which it has been shown that additional signals from imaging improve risk stratification[2]. Within medical imaging techniques, retinal photography analysis has gained popularity due to its noninvasive and cost-effective nature[3]. Retinal fundus images (RFI) are obtained from the projection of the rear part of the eye (fundus) onto a 2D plane using a monocular camera. Different biomarkers and eye structures can be identified from a RFI, playing an important role in identifying retinal abnormalities and diseases, such as glaucoma, diabetic retinopathy (DR), macular edema degeneration, etc. In recent years, deep learning applied to oculomics has aroused great interest in the scientific community[4][5]. Studies on the identification and prediction of ocular biomarkers of systemic diseases are becoming increasingly interesting for researchers in the field.

II. Literature Survey

1] Heart Disease Prediction
Year of Publication: 2021. Author: Sibgha Taqdees.
Method: There are different algorithms to predict heart disease like naive Bayes, k Nearest Neighbour[KNN], Decision tree, Artificial Neural Network [ANN][6].
Pros: Multiple Algorithms used. Cons: Less Accuracy.

2] Heart Disease Prediction Using Machine Learning Algorithms.
Year of Publication: 2020. Author: Harsit Jindal.
Method: The strength of proposed model was quiet satisfying and was able to predict evidence of having heart disease in particular individual by using KNN and Logistic Regression which showed good accuracy[7].

Pros: Extended Accuracy.
Cons: The training database consists less data.

3] Machine Learning-Based Classification Algorithms For The Prediction Of Coronary Heart Diseases.
Year of Publication: 2021.
Author: Kelvin Kwakye, E Dadzie.
Method: The current study created and tested several machine learning based classification models.The dataset was subjected to smote to handle unbalanced classes and feature selection technique in order to assess the impact on to distinct performance matrices.
Pros: Faster Algorithm.
Cons: Less features considered. Heart Attack risk prediction using Retinal Images.

4] Optimal Prediction Of Heart Disease Using Machine Learning Techniques With Logistics Regression Model.
Year of Publication: 2022.
Author: Ghulab Nabi Ahmad, Hira Fathima, Shafiuallah.
Method: Heart disease prediction algorithm based on the analysis of the predictive models classification performance on combined datasets and the train-test split technique is presented. Pros: High Resolution dataset used.
Cons: Slow operation.

5] An Improved Machine Learning Technique With EffectiveHeart Diseases Prediction System.
Year of Publication: 2021.
Author: Mohammad Tabrez Quasim.
Method: Our proposed method offers an illustrative framework that helps predict heart attacks with high accuracy.
Pros: Web App supported. Cons: Low accuracy.

III.Proposed Work

The goal of this system is to a develop Heart Disease Prediction system that can recognize heart disease using retinal images. The changes in the eye can be an indication of many symptoms. The classifiers like Support Vector Machine Classifier (SVM) and Random Forest Classifier (RFC) are used to identify and the results are compared.

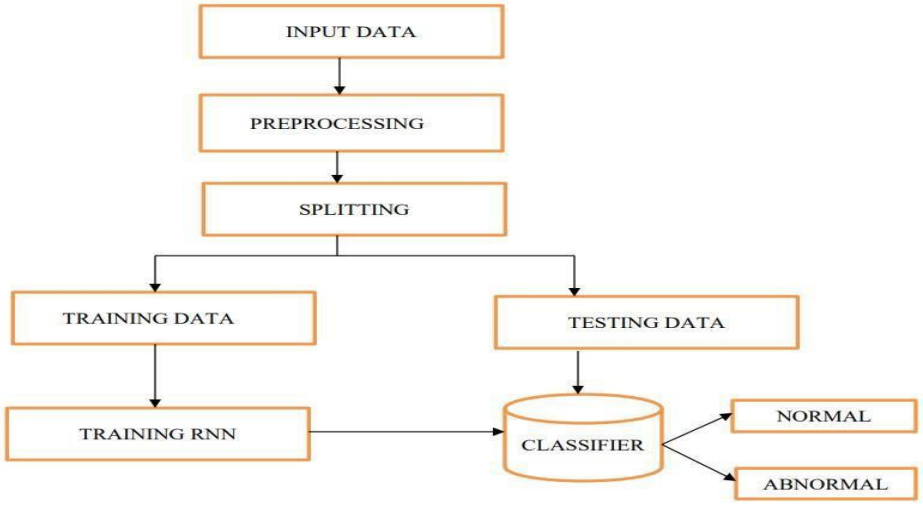

Fig 3.1: Module Diagram Of Project

1) Data Preparation.

The training dataset for the image quality screening system was in a similar manner to our prior THEIA system. After the screening process there were 95,992 images from 51,956 patients. Due to patients visiting Biobank for repeated assessment visits, there were multiple sets of biometric information per patient. Here, only the earliest images and set of biometrics were used per patient. Dataset processing was also carried out on the dataset. A similar image screening pre-processing strategy was employed for the dataset, and the biometric information and fundus images from the first visit only. After screening for image quality, there were 134,476 images from 3,162 patients left for test analysis.

2) Image segmentation/Extraction of blood vessels

Retinal blood vessel extraction is a process to get a binary vessel map where retinal blood vessels are labeled as logic 1 (white) and retinal background pixels are labeled as logic 0 (black) or vice versa. In this step, the thickness of the blood vessel is identified. The area of the blood vessel is calculated to identify the stage of the disease. If the blood vessels are found to be thick then the person is more prone to heart disease. After calculating the area, the next step is the extraction of features.

3) Project Outcome

The "attribution score" for an input field, such as age, represents the amount of difference this particular field contributed to the value difference between the predicted CVD risk for this particular patient and that of the entire source dataset. The attribution score for the following key fields were calculated as these factors have been identified as the major contributing factors to an individual cardiovascular risk by the American College of Cardiolog :

1. Age
2. SBP
3. DBP
4. BMI
5. HbA1c
6. Risk of Heart Attack.

The attribution scores for all other input fields into the CVD risk prediction model were categorized and summated under the "others aggregated" category.

IV. Results

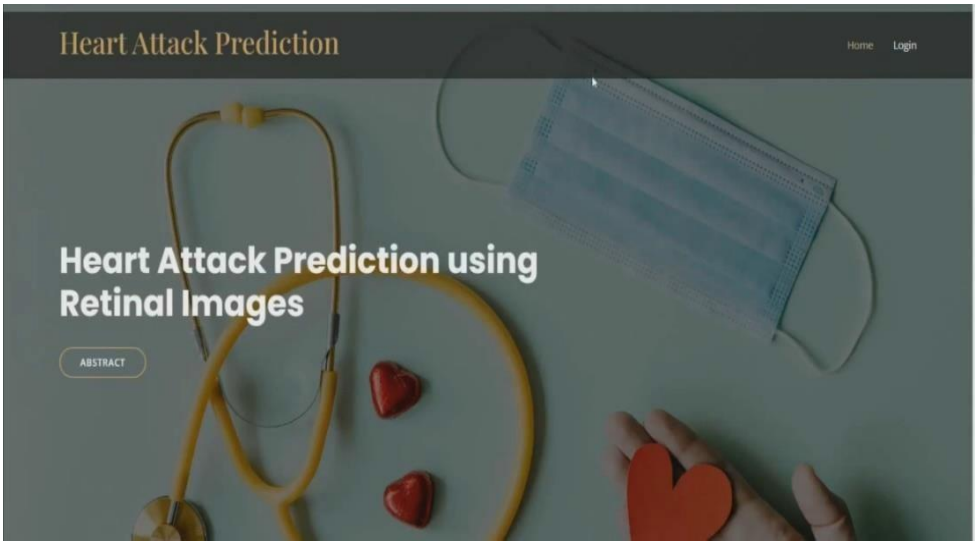

Figure 4.1 : Home page

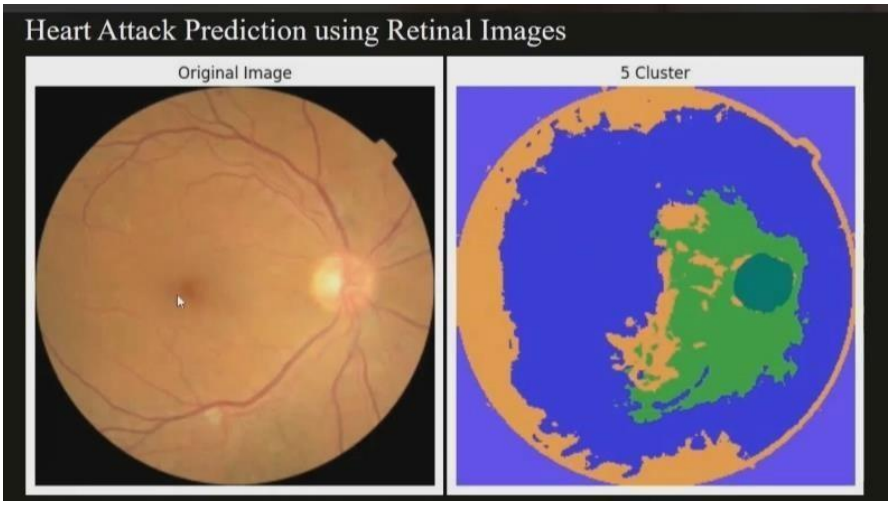

Figure 4.2: After Image Segmentation

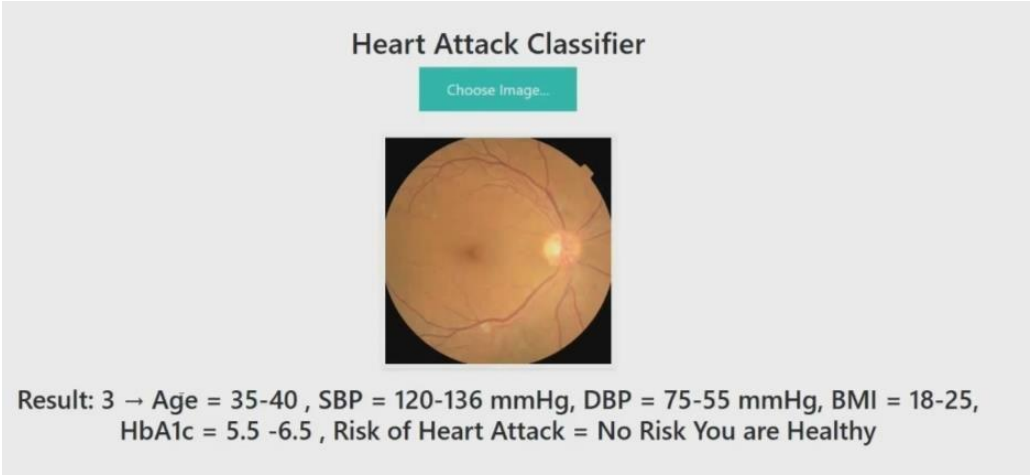

Figure 4. 3: Risk Prediction.

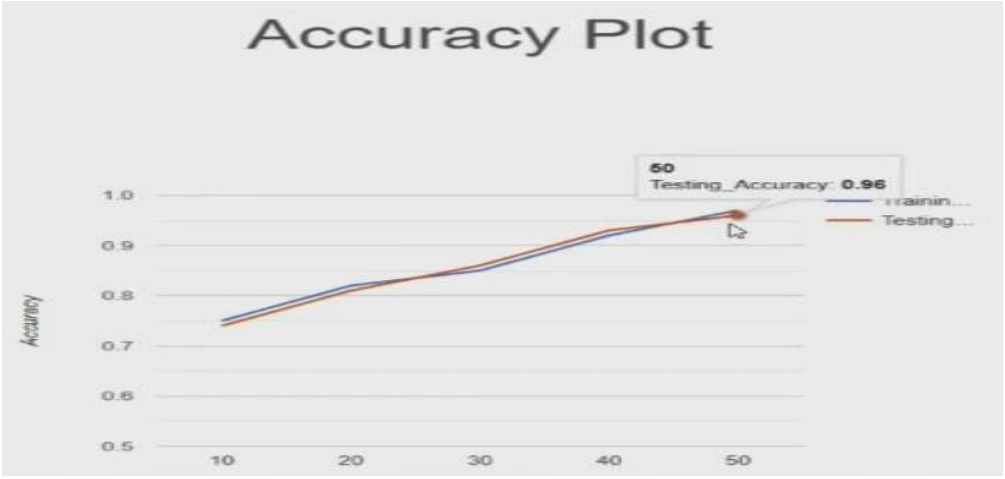

Figure 4.4: Performance Analysis.

V. Conclusion

In conclusion, our project, "Heart Attack Risk Prediction Using Retina Images," represents a novel and promising approach to enhancing cardiovascular disease risk assessment. By leveraging advanced

techniques such as Fuzzy C-Means clustering and Recurrent Neural Networks (RNNs), we can successfully harness the power of medical imaging data to predict heart attack risk. Through careful feature selection, data preprocessing, and optimal cluster determination, we have strived to create an efficient and accurate model. Furthermore, our integration of fuzzy logic and supervised classification models has allowed for the differentiation of normal and abnormal cases, enabling timely interventions[8][9]. As we continue to fine-tune and expand this project, we envision it becoming an invaluable tool in the healthcare industry, facilitating early detection, prevention, and management of heart-related issues[10]. Our pursuit of using retinal images for heart attack risk prediction underscores the potential for innovation at the intersection of medical imaging and machine learning, opening new horizons for cardiovascular health monitoring.

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