IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 4, April 2024

DOI: 10.17148/IJARCCE.2024.134199

PREDICTING THE RISK OF HEART ATTACK USING RETINAL EYE IMAGE ANALYSIS

Asst Prof. Rumana Anjum, Abdul Mohiyuddin, Girisha S, Manupriya B Patil, Nandish D S

Department of Computer Science and Engineering,

Vidya Vikas Institute of Engineering and Technology, Mysore, Karnataka

Abstract: Globally, cardiovascular diseases (CVDs) continue to be the primary cause of morbidity and mortality. In order to enhance patient outcomes and lessen the strain on healthcare systems, early detection and intervention are essential. Changes in retinal vascular structure may have an impact on cardiovascular health, according to recent studies. Retinal pictures are a desirable source of data for predictive modelling because they provide a non-invasive way to evaluate micro vascular abnormalities. The goal of this project is to create a machine learning model that analyses retinal images and looks for patterns that could indicate heart illness. Specifically, this model uses Recurrent Neural Networks (RNNs). Because RNNs are good at processing sequential data, they can be used to better forecast the model and capture temporal dependencies in retinal pictures.

I. INTROUDCTION

Heart disease, a class of disorders affecting the heart or blood arteries, is sometimes referred to as cardiovascular disease. It's a general word that covers a wide range of cardiovascular system disorders. Heart attacks can result from coronary artery disease, the most prevalent kind of heart disease.The goal of this machine learning project is to use retinal image analysis to identify cardiac problems using Recurrent Neural Networks (RNNs). The possible relationship between retinal features and cardiovascular health has drawn attention to the use of retinal imaging as a diagnostic tool. Since the retina is a neural tissue and the circulatory system has similar vascular structures, anomalies in the retina's vascular structure may be signs of underlying cardiac issues. There are vascular parallels between the retina, which is found in the back of the eye, and the cardiovascular system. Microvascular alterations or abnormalities in the retinal blood vessels may be indicative of problems with the systemic circulation, including heart-related ailments.

A kind of artificial neural networks called recurrent neural networks (RNNs) is made to process sequential data and identify patterns over time. RNNs are different from standard neural networks in that they feature connections that form network cycles, which enable the network to retain a memory of past inputs. This research aims to improve the precision and efficacy of heart disease detection by utilizing RNNs, which are particularly good at processing sequential data. This will help to promote early diagnosis and prompt intervention. This research is important since it offers a non-invasive, possibly economical technique for early identification of cardiac disease. If effective, the use of retinal pictures as a diagnostic tool may provide a proactive method of evaluating cardiovascular health.

II. LITERATURE SURVEY

1. Heart Attack Risk Prediction Using Retinal Eye Images Based On Machine Learning and Image Processing

In recent years, heart disease has become a global cause of death. Therefore, a model that can more accurately anticipate the onset of cardiac disease at an early stage must be created. Thus far, invasive stress tests, ECGs, and blood tests have been used for detection. In this effort, retinal image data is used to predict heart disease using a non-invasive manner. Because heart and eye health are related, a Chase image dataset is taken into consideration. Here, alterations in the microvasculature, which is seen from the retina, can be used to identify heart issues. Disease prognosis takes into account characteristics such as blood vessel size, uneven background lighting, etc. Image processing is what we do.

2. PREDICTION OF HEART DISEASE USING RETINAL IMAGES

Globally, the death rate from heart disease has increased recently. Thus, it is imperative to create a model that can more accurately and early forecast the development of cardiac disease. Up until recently, intrusive stress tests, ECGs, and blood tests have been used to discover abnormalities. In this effort, a non-invasive approach using retinal image data is used to predict cardiac disease. Given the correlation between heart and eye health, a Chase image dataset is taken into consideration. Changes in the microvasculature, which is seen from the retina, can be used to diagnose heart issues in

ISSN (O) 2278-1021, ISSN (P) 2319-5940
International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⪤ Peer-reviewed & Refereed journal ⪤ Vol. 13, Issue 4, April 2024
DOI: 10.17148/IJARCCE.2024.134199

this case. The number of blood vessels, uneven backdrop lighting, and other characteristics are taken into account when predicting disease.

3. An Overview of Deep-Learning-Based Methods for Cardiovascular Risk Assessment with Retinal Images

Cardiovascular diseases (CVDs) represent a significant source of preventable mortality. It is essential to recognize CVDs early in order to prevent them and treat them quickly. Retinal fundus imaging (RFI), according to recent developments in oculomics, can provide useful data for the early identification of a number of systemic disorders. A huge corpus of RFI that has been methodically gathered for the diagnosis of disorders associated to the eyes may be utilized to prevent CVDs. However, public health systems cannot afford to assign highly qualified medical professionals to handle this data alone, which highlights the need for automated diagnosis technologies that can identify high-risk individuals and sound an alarm. Deep learning models, in particular, and artificial intelligence (AI) have emerged as a potent substitute for computerized pre-diagnosis in patient risk retrieval. This work offers a fresh review..

4. Heart Disease Prediction Using Eye Retinal Images

Globally, cardiovascular disease (CVD) continues to be the primary cause of morbidity and mortality. For efficient prevention and prompt intervention, cardiovascular disease risk assessment and early identification are critical. an examination of deep learning techniques for RFI-based CVR prediction. The retina offers a unique opportunity for reliable medical diagnosis because it is an extension of the central nervous system. We have created a novel deep learning model for the prediction of various critical parameters related to cardiovascular illnesses, utilizing a variety of retinal fundus images, patient information, and clinical data. Relevant features can be extracted from retinal pictures using CNN without the need for any manual processes. Our study's primary goal is to forecast the risk factors of hypertension, diabetes, and hyperlipidemia.

5. Cardiovascular Disease Diagnosis from DXA Scan and Retinal Images Using Deep Learning

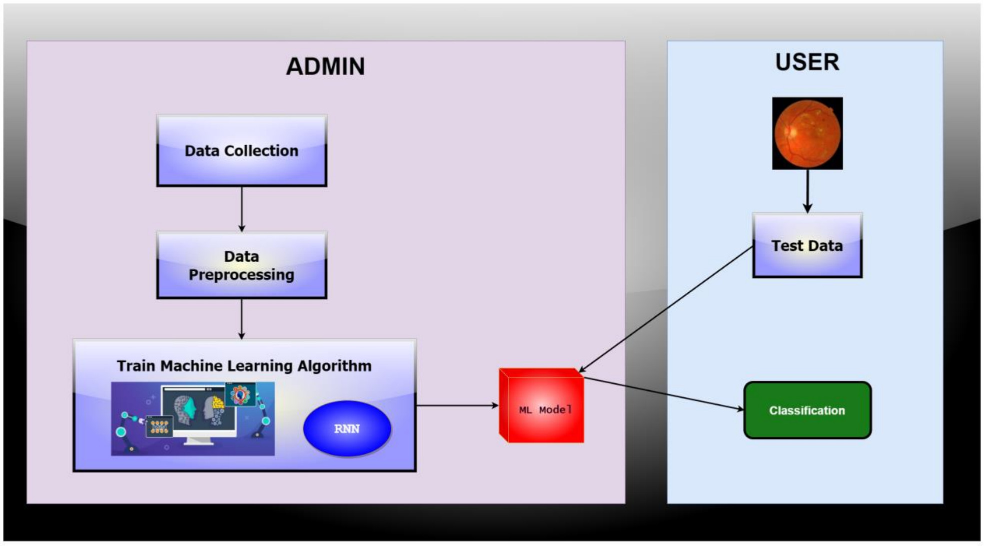
Globally, cardiovascular diseases (CVD) constitute the primary cause of death. Individuals with cardiovascular diseases (CVDs) could not receive a diagnosis until a major heart failure event, such as a heart attack, stroke, or myocardial infraction, occurs. Studies on the diagnosis of CVD using non-invasive techniques like dual-energy X-ray absorptiometry (DXA) or retinal imaging are scarce in Qatar. Our goal in this work was to diagnose CVD with a unique method that combined data from DXA and retinal pictures. A cohort of 500 adult Qatari participants was taken into consideration, with an equal number of participants from the CVD and control groups, drawn from Qatar Biobank (QBB). To suggest a profound understanding, we created a case-control research using a novel multi-modal approach that combined data from different modalities—DXA and retinal pictures.

6. Predicting Cardiovascular Risk Factors from Retinal Fundus Photographs using Deep Learning

Medical discoveries are typically made by first identifying correlations and then formulating testable hypotheses through experimentation. However, because real data has a vast range of features, patterns, colors, values, and shapes, it can be challenging to see and quantify relationships in images. In this study, we employ self-learning machine learning, or deep learning, to extract novel information from retinal fundus images. We predict cardiovascular risk factors not previously believed to be present or quantifiable in retinal images, such as age (within 3.26 years), gender (0.97 AUC), smoking status (0.71 AUC), HbA1c (within 1.39%), systolic blood pressure (within 11.23mmHg), and other variables using models trained on data from 284,335 patients and validated on two independent datasets of 12,026 and 999 patients.

III. METHODOLOGY

1. PROPOSED METHODOLOGY



ISSN (O) 2278-1021, ISSN (P) 2319-5940
International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⋇ Peer-reviewed & Refereed journal ⋇ Vol. 13, Issue 4, April 2024
DOI: 10.17148/IJARCCE.2024.134199

- **Data Collection:**

Gather retinal images from people with a range of cardiovascular health conditions to create a representative and diverse dataset. Make sure the dataset includes a variety of age groups, demographics, and risk factors. Include annotations specifying if each person is healthy or has a known cardiovascular ailment..

- **Data Preprocessing:**

To guarantee homogeneity and eliminate unnecessary information, preprocess the data. Standardize the resolution, color channels, and any other pertinent retinal image properties to ensure consistency across the collection. Eliminate any artifacts or unnecessary information that would not help with the job of detecting heart disease. Image cropping, masking, or noise reduction may be used in this step.

- **Model Development:**

Create and put into use an RNN-based architecture that can handle data from consecutive retinal images. Utilizing the prepared dataset, train the RNN-based model. The model gains the ability to identify relationships and patterns in the successive retinal pictures and the labels that correlate to them throughout training. Make sure the model is as sensitive and specific as possible. Specificity reduces false positives while sensitivity guarantees the model can identify true positives.

- **Model Evaluation and Validation:**

Utilizing pertinent metrics, evaluate the constructed model's performance. To make sure the model is generalizable, validate it on different datasets. Analyze the model by using measures like accuracy.

- **Testing and deployment:**

To assess the trained model's ultimate performance on unobserved data, use the testing dataset. Once the model's performance is acceptable, it can be used to identify heart problems and make predictions on fresh retinal images.

The suggested system will be created with Flask, a web application framework, and Python. Python's Flask framework is a lightweight, modular web application framework. It is a well-liked option for creating small to medium-sized web apps because of its simplicity. The tools required for handling, routing, and formatting HTTP requests are provided by Flask.

The objective is to create a strong RNN-based model for retinal image-based heart disease diagnosis by adhering to this suggested technique, making sure that model performance and data quality are given top priority during the entire process.

2. Algorithm – RNN:

Recurrent Neural Networks (RNNs) play a critical role in the analysis of sequential data, such as the vascular patterns found in the retina, when it comes to the detection of heart illnesses utilizing retinal images. Because RNNs have memory mechanisms built into them, they are able to remember dependencies over time, which allows them to identify minute changes in retinal traits that are indicative of cardiovascular health. RNNs generate significant features from retinal sequences by utilizing Long Short-Term Memory (LSTM) cells to address long-term dependencies. This makes it easier to identify anomalies linked to heart problems. The RNN contributes to the integration of diagnostic systems for early detection and intervention by learning to map retinal pictures to disease labels through iterative training and optimization. RNNs are essentially essential for improving the precision and effectiveness of heart disease detection from retinal images

To write down the mathematical formula for heart disease prediction using retinal images, we can frame it as a supervised learning problem where we aim to predict the probability of heart disease based on features extracted from retinal images. Let's denote the input features as X and the output prediction as y, where X represents the retinal image features and y represents the probability of heart disease.

We can use a machine learning model, such as an RNN (Recurrent Neural Network), to learn the mapping from X to y. The general formula for predicting heart disease probability using an RNN can be represented as:

$$y = f(W_{\text{RNN}} \cdot X + b_{\text{RNN}})$$

where:
- W_{RNN} is the weight matrix of the RNN,
- b_{RNN} is the bias vector of the RNN,
- f is the activation function (e.g., sigmoid function for binary classification),
- X is the input features extracted from retinal images,
- y is the predicted probability of heart disease.

In the context of an RNN, the input features X can be represented as a sequence of feature vectors if temporal information is important in the data. For example, if the retinal images are captured over time and sequential patterns are relevant for heart disease prediction, then X could be a sequence of feature vectors $[x_1, x_2, ..., x_T]$, where T is the number of time steps or images in the sequenceThe RNN processes this sequence of feature vectors through time steps using its internal recurrent connections, and the final output y is obtained after processing all time steps.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⋇ Peer-reviewed & Refereed journal ⋇ Vol. 13, Issue 4, April 2024

DOI: 10.17148/IJARCCE.2024.134199

The specific architecture of the RNN (e.g., LSTM, GRU) and the details of feature extraction from retinal images would determine the exact form of W_{RNN}, b_{RNN}, and the activation function f. These parameters are learned during the training process, where the model optimizes them to minimize a chosen loss function (e.g., binary cross-entropy) based on the available labeled data.

IV. RESULTS & DISCUSSION

An artificial neural network type called a recurrent neural network (RNN) is made to process sequential data. RNNs are different from standard feed forward neural networks in that they have cycles in their connections, which enables them to retain a memory of past inputs. RNNs are useful for applications like time series prediction, natural language processing, and the study of sequential visual data, such as retinal scans, because of their memory mechanism, which allows them to process data sequences. Leveraging the sequential nature of image data is important when using Recurrent Neural Networks (RNNs) with retinal image datasets, especially when working with temporal or spatial sequences within images. RNNs are often used for sequential data, such as time series, but they may be modified to work with picture datasets by either considering the image as a series of pixels

V. CONCLUSION

Recurrent neural networks (RNNs) are a potent kind of neural networks that are especially made to handle sequential input, to sum up. Their versatility in detecting temporal relationships and retaining memory throughout sequences makes them ideal for a range of uses, such as the analysis of retinal pictures to detect heart problems. RNNs can be used on sequential data from medical imaging, time-series physiological measures, or other pertinent sources in the context of cardiovascular health. The use of RNNs in the field of retinal image-based heart disease detection creates new opportunities for precise and dynamic evaluations, promoting early diagnosis and tailored therapies. Improved cardiovascular healthcare is expected to be greatly aided by ongoing research and development in this field as well as developments in machine learning techniques.

REFERENCES

[1]. Adler ED, Voors AA, Klein L, Macheret F, Braun OO, Urey MA et al (2020) Improving risk prediction in heart failure using machine learning. Eur J Heart Fail 22(1):139–147. https://doi.org/10.1002/EJHF.1628

[2]. Akbilgic O, Butler L, Karabayir I, Chang P, Kitzman D, Alonso A et al (2021) Artificial intelligence applied to ecg improves heart failure prediction accuracy. J Am Coll Cardiol 77(18):3045. https://doi.org/10.1016/S0735-1097(21)04400-4

[3]. Albert KF, John R, Divyang P, Saleem T, Kevin MT, Carolyn JP et al (2019) Machine learning prediction of response to cardiac resynchronization therapy: improvement versus current guidelines. Circ Arrhythmia Electrophysiol, vol 12(7). https://doi.org/10.1161/CIRCEP.119.007316

[4]. Ali MM, Paul BK, Ahmed K, Bui FM, Quinn JMW, Moni MA (2021) Heart disease prediction using supervised machine learning algorithms: performance analysis and comparison. Comput Biol Med 136:104672. https://doi.org/10.1016/J.COMPBIOMED.2021.104672

[5]. Araujo M, Pope L, Still S, Yannone C (2021) Prediction of heart disease with machine learning techniques. Graduate Res, Kennesaw State Un

[6]. Breiman L (2001) Random forests. Mach Learn 45(1):5–32. https://doi.org/10.1023/A:1010933404324

[7]. Caruana R, Karampatziakis N, Yessenalina A (2008) An empirical evaluation of supervised learning in high dimensions. In: Conference: machine learning, proceedings of the twenty-fifth international conference (ICML 2008), Helsinki, Finland

[8]. Dalal S, Onyema EM, Kumar P, Maryann DC, Roselyn AO, Obichili MI (2022) A hybrid machine learning model for timely prediction of breast cancer. Int J Model Simul Sci Comput 0(0):2341023. https://doi.org/10.1142/S1793962323410234

[9]. Diwakar M, Tripathi A, Joshi K, Memoria M, Singh P, Kumar N (2021) Latest trends on heart disease prediction using machine learning and image fusion. Mater Today: Proc 37(Part 2):3213–3218. https://doi.org/10.1016/J.MATPR.2020.09.078