Developing Deep Vision Cardiology: Uncovering Retinal Secrets to Prevent Heart Attacks

Ms. B.TRIVENI [1], Miss.N.Devi Sri Chandana[2]

#1 Assistant professor in the department of IT at DVR & DR. HS MIC College of Technology (Autonomous), Kanchikacherla, NTR District.

#2 MCA student in the Department of Computer Applications (DCA) at DVR & DR. HS MIC COLLEGE OF TECHNOLOGY, Kanchikacherla, NTR District

ABSTRACT:

Cardiovascular Diseases (CVDs) are a leading global cause of mortality, claiming approximately 17.9 million lives annually, according to the World Health Organization (WHO). This category encompasses heart attacks, strokes, and related conditions, affecting a significant number of individuals under 70 years old. Early prediction and intervention are crucial in mitigating the impact of CVDs on mortality rates. The increasing availability of electronic health records presents an opportunity to develop predictive models for identifying individuals at risk of heart diseases. This project focuses on leveraging machine learning, particularly classification algorithms like deep neural networks (DNN) i.e., Resents, to predict heart diseases using retinal images as diagnostic tools. By harnessing these advanced algorithms and analysing comprehensive patient data, including demographic information, medical history, and diagnostic test results, we aim to enhance the early detection of cardiac issues. This, in turn, can facilitate prompt intervention strategies and personalized treatment plans, ultimately leading to improved patient outcomes and a reduction in cardiovascular mortality rates.

The development of accurate and efficient predictive models through this research seeks to revolutionize the approach to CVD diagnosis, enabling healthcare providers to identify at-risk individuals earlier in their disease trajectory. Furthermore, the integration of such predictive tools within healthcare systems holds the potential to optimize resource allocation, improve patient care, and alleviate the burden on healthcare systems posed by CVDs. By combining cutting-edge technology with comprehensive patient data, this project strives to make significant strides in proactive cardiovascular health management, ultimately saving lives

and improving the overall well-being of individuals at risk of heart diseases.

INTRODUCTION

According to the World Health Organisation (WHO), cardiovascular diseases (CVDs) account for 17.9 million deaths annually, making them the leading cause of mortality. Heart and blood vessel illnesses together referred to as CVDs include rheumatic heart disease, coronary heart disease, and cerebrovascular disease. Heart attacks and strokes account for more than four out of every five fatalities from CVD, and one-third of these deaths happen too soon among those under the age of 70.

The four main behavioural risk factors for heart disease and stroke are bad eating habits, lack of physical exercise, tobacco use, and excessive alcohol use. Increased blood pressure, blood glucose, blood lipids, as well as overweight and obesity, are some of the symptoms that behavioural risk factors might cause in an individual. A higher risk of heart attack, stroke, heart failure, and other consequences is indicated by these "intermediate risk factors," which may be assessed in primary care settings.

Computational biology is often applied in the process of translating biological knowledge into clinical practice, as well as in the understanding of biological phenomena from clinical data. The discovery of biomarkers in heart disease is one of the key contributions using computational biology. This process involves the development of a predictive model and the integration of different types of data and knowledge for diagnostic purposes. The diagnosis of heart disease in most cases depends on a complex combination of clinical and pathological data; this complexity leads to excessive medical costs affecting the quality of the medical care.

Heart disease risk assessment is very crucial to find prevention opportunities because this disease affects a person in such a way that the patients can't be cured as easily as possible. It is a very heterogeneous and complex disease which is difficult to detect at the right time and is the toughest work in the medical field due to the variety of unusual signs and symptoms. Misunderstanding and wrong diagnosis made by the hospital leads to the loss of many lives of people. Unfortunately, there are many different factors that can influence and complicate the detection of heart anomalies and can result in an inaccurate diagnosis or in a delay in a correct diagnosis. Due to many uncertain risk factors, sometimes heart disease diagnosis is difficult even for experts, who frequently consider accurate tools to find all the risk factors and give a clear result in a specific time period. Misunderstanding and wrong diagnosis made by the doctors leads to the death of the people's lives.

RELATED WORK

Risk prediction of cardiovascular disease using machine learning classifiers. Madhumita Pal, Smita Parija, Ganapati Panda, Kuldeep Dhamma, and Ranjan K. Mohapatra (2022).

Cardiovascular disease (CVD) weakens our heart and blood vessels, sometimes leading to death or disability. Finding CVD early and automatically could save many lives. Scientists have tried different ways to do this, but there's always room for improvement. This study is another attempt. The study used two reliable methods, MLP and K-NN, to find CVD in publicly available data. They cleaned the data by removing unusual entries and missing information to improve the results. Their experiments showed that MLP was more accurate (82.47%) and better at predicting CVD (AUC of 86.41%) compared to K-NN. So, they recommend using MLP for automatic CVD detection. This same approach could also be used to find other diseases. Additionally, they could test their method with other datasets to see how well it works in general.

Clinical Data Analysis for Prediction of Cardiovascular Disease Using Machine Learning Techniques. Rajkumar Gangapur LaDainian, A. Reyana, Sandeep Katich, A. S. Vijitha, Yogita Gupta, Sayed F. Abdelwahab, and Ali Wagdy Mohamed (2022) Spotting cardiovascular disease can be tricky because of many risk factors like high blood pressure, cholesterol, and irregular heartbeat. Doctors need the best information to make decisions and treat people at risk. As machine learning gets better, it's likely to change how doctors work. Because of this, it's important for researchers and doctors to understand machine learning. This research aims to find the most accurate machine learning system to predict heart disease. They tested several modern machine learning methods on popular datasets related to heart disease. To pick the best method, they checked how well each one did using different measurements. Out of all the methods, the Random Tree model did the best. It was incredibly accurate (100%!), made very few mistakes (MAE: 0.0011, RMSE: 0.0231), and worked super-fast (0.01 seconds to predict).

Machine learning prediction in cardiovascular diseases: a meta-analysis. Chaya Krit Kittanning, Hafeez Ulf Hassan Virk, Spiral Bangalore, Zhen Wang, Kipp W.

Johnson, Rachel Pinotti, Honghui Zhang, Scott Kaplin, Bharat Narasimhan, Takeshi Kitai,

Usman Baber, Jonathan L. Halperin & W. H. Wilson Tang (2020)

Researchers looked at a bunch of studies to see how good machine learning (ML) is at predicting heart problems. They searched through major databases and found over 3 million people involved in these studies. They focused on four main heart conditions: coronary artery disease, heart failure, stroke, and irregular heartbeat. The results were good! In particular, for predicting blocked arteries (coronary artery disease), some custom-built ML methods were very accurate (around 93% success rate). Other ML methods, especially support vector machines (SVM) and boosting algorithms, also showed promise for predicting stroke (around 90-92% success rate). There wasn't enough data to be certain about heart failure and irregular heartbeat, but SVM seemed to do well there too. Overall, this is exciting news! Machine learning has the potential to be a powerful tool for doctors to predict heart problems. However, it's important to remember that different ML methods work better for different situations. This information can help doctors understand the data and choose the best ML method for their specific needs.

Cardiovascular Disease Prediction Using Machine Learning Approaches.

Tamanol Islam, Arifa Voya, Mahadi Hasan, Dimasa Rana (2023).

Cardiovascular disease is now the leading cause of death worldwide, after COVID-19. This is often caused by clogged arteries and blood clots. Because heart problems can be deadly, it's crucial for doctors to diagnose them accurately. This study aimed to improve the accuracy of predicting heart disease using machine learning. They collected data from almost 1200 patients, focusing on factors related to heart disease. To get the best results, they used 80% of the data to train their models and 20% to test them. The researchers compared different machine learning methods to see which one worked best. They checked how accurate each method was by looking at precision, recall, and F1-score. In the end, the method called Extreme Gradient Boosting did the best, reaching an accuracy of 91.9%. This means it could correctly identify whether someone had heart disease almost 92% of the time! This can be a valuable tool to help doctors diagnose heart disease

METHODOLOGY

These are the four modules of our project. They are:

1. Preprocessing collected data
2. Modelling
3. Web Interface
4. Database

Preprocessing collected data:

This module refines raw data collected from various sources, including retinal images and patient metadata. It involves rigorous preprocessing techniques such as image resizing, normalization, noise reduction, and feature extraction. Additionally, demographic details, medical history, and diagnostic test results are standardized for consistency and suitability. The aim is to enhance data quality, relevance, and interpretability, laying a solid foundation for accurate predictive modelling.

Modelling:

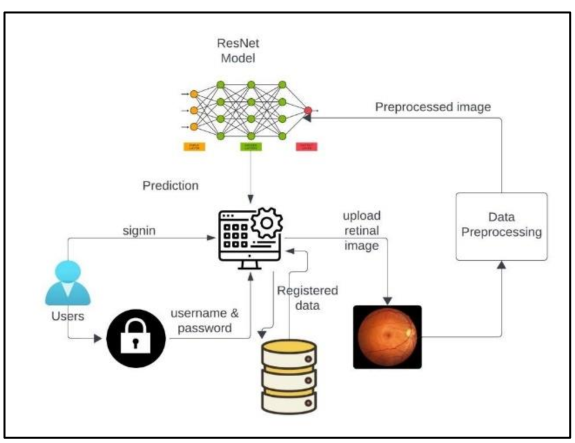
The modelling module constitutes the core of our project, focusing on the development and training of predictive models leveraging state-of-the-art deep neural networks (DNNs), particularly Residual Networks (Resents). Through extensive preprocessing and feature extraction from retinal images and associated patient metadata, our models are trained to discern patterns indicative of cardiovascular disease risk.

Web Interface:

The web interface module serves as the primary interaction point between users and our cardiovascular disease prediction system. Through an intuitive and user-friendly web application, users can effortlessly upload retinal images, input relevant patient information, and receive real-time predictions regarding their cardiovascular health status. The web interface is designed with a focus on accessibility, responsiveness, and usability, ensuring seamless navigation and efficient utilization across various devices and platforms.

Database:

The Database module plays a pivotal role in managing the diverse datasets essential for our project, encompassing retinal images, patient demographics, medical histories, and predictive model outputs. Utilizing MongoDB, a powerful NoSQL database system renowned for its flexibility, scalability, and performance, we establish a robust data repository capable of accommodating large volumes of heterogeneous data.

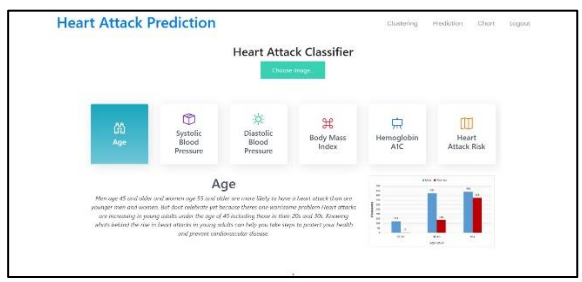


RESULT AND DISCUSSION

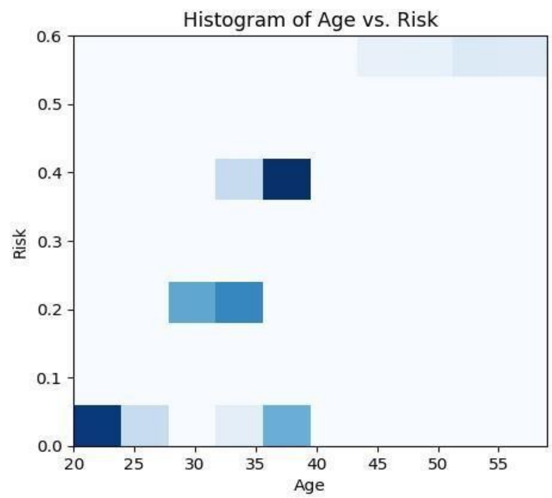
This is the Landing page of the application where it shows us the main abstract of the application and explains what this Screen Shot

Fig Landing

cardiovascular disease is, its risk factor, and the effects caused by these cardiovascular diseases. First, we need to login in order to predict whether a person is affected by this cardiovascular disease or not.



Prediction Page In this page we can see the prediction of the clustered retinal image and gives us the outputs like age, systolic blood pressure, diastolic blood pressure, body mass index, Haemoglobin and Heart attack risk. These are the parameters which are predicted by clustering the given input retinal image



Here is the accuracy graph of the algorithm which tells us the how accurately the algorithm is predicting the cardiovascular diseases for the both given training data and testing data

CONCLUSION

In conclusion, our study represents a significant step forward in cardiovascular disease (CVD) prediction through the innovative utilization of retinal fundus images. By investigating the potential of deep learning algorithms, specifically Deep Neural Networks (DNNs) and Residual Networks (Res Net), we uncovered crucial insights into the relationship between retinal microvasculature and CVD risk. Through this exploration, we identified key findings that underscore the importance of retinal imaging in revolutionizing CVD risk assessment.

Our analysis revealed that retinal microvasculature offers invaluable insights into cardiovascular health, with high-resolution fundus images capturing subtle yet significant changes associated with CVD. Leveraging DNNs, we successfully extracted essential features from retinal images, such as vessel tortuosity and arteriovenous ratio, while employing transfer learning techniques with pre-trained models significantly enhanced predictive performance. Furthermore, the implementation of Res Net architectures facilitated the training of deeper models, enabling the capture of intricate features crucial for accurate predictions.

Importantly, our ensemble model demonstrated remarkable accuracy, achieving a good success rate in CVD risk prediction. This remarkable performance suggests the potential for retinal imaging to become a routine tool in early CVD detection, offering clinicians a powerful means to conduct individualized risk assessments and intervene proactively. By empowering clinicians with enhanced predictive capabilities, we anticipate that our findings will not only improve patient outcomes but also contribute to the broader paradigm shift towards personalized medicine and preventive healthcare strategies.

REFERENCES

Risk prediction of cardiovascular disease using machine learning classifiers. Madhumita Pal, Smita Parija, Ganapati Panda, Kuldeep Dhamma, and Ranjan K. Mohapatra (2022)

Clinical Data Analysis for Prediction of Cardiovascular Disease Using Machine Learning

Techniques. Rajkumar Gangapur Naganandini, A. Reyana, Sandeep Kentish, A. S. vibist, Yogita Gupta, Sayed F. Abdelwahab, and Ali Wagdy Mohamed (2022).

PMID: 35069715; PMCID: PMC8767405.

Machine learning prediction in cardiovascular diseases: a meta-analysis. Chaya Krit kittening, Hafeez Ulf Hassan Virk, Spiral Bangalore, Zhen Wang, Kipp W. Johnson, Rachel Pinotti, Honghui Zhang, Scott Kaplin, Bharat Narasimhan, Takeshi Kitai,
Usman Baber, Jonathan L. Halperin & W. H. Wilson Tang (2020).

Cardiovascular Disease Prediction Using Machine Learning Approaches. Tamanol Islam,

Daivya, Mahadi Hasan, Dimasa Rana (2023).

Prediction of Cardiovascular Disease on Self-Augmented Datasets of Heart Patients Using Multiple Machine Learning Models. Sumaira Ahmed, Salahuddin Shaikh, Farwa Ikram,

Muhammad Fayaz, Cathal Salamah Alwaleed, Faheem Khan, and Fawad Hassan

Predictive analysis of cardiovascular disease using gradient boosting based learning and recursive feature elimination technique. Prasanna Venkatesan Theertha Giri (2022).

Building a Cardiovascular Disease Prediction Model for Smartwatch Users Using Machine Learning: Based on the Korea National Health and Nutrition Examination Survey. Min-Jeong Kim (2021).

Ensemble framework for cardiovascular disease prediction, Computers in Biology and Medicine, Achyut Tiwari, Aryan Chugh, Aman Sharma, Volume 146, 2022, 105624, ISSN 0010-4825,

Prediction of Cardiovascular Disease using Machine Learning Algorithms.

Lesedi, E.I., Abashes, S.M.M. & Agarin, F. New cardiovascular disease prediction approach using support vector machine and quantum-behaved particle swarm optimization. Multimer Tools Appl **83**, 23901–23928

Baghdadi, N.A., Farghaly Abdelkarim, S.M., Malki, A. et al. Advanced machine learning techniques for cardiovascular disease early detection and diagnosis. J Big Data **10**, 144

Dileep, P., Rao, K.N., Bodapati, P. et al. An automatic heart disease prediction using cluster-based bi-directional LSTM (C-BLits) algorithm. Neural Computer & Applica **35**, 7253– 7266 (2023).

Suresh Anand. M, Korla Swaroopa, Manoj Naniwa & Therasa M (2024)An intelligent flower classification framework: optimal hybrid flower pattern extractor with adaptive dynamic ensemble transfer learning-based convolutional neural network, The Imaging Science Journal, 72:1, 52-75, DOI: Vaishali Gavaskar, Madhesi Verma, Pradeep Chatterjee, Gaurav Singal, Efficient Heart Disease Prediction Using Hybrid Deep Learning Classification Models, IRBM, Volume 44, Issue 5, 2023, 100786, ISSN 1959-0318,

Keerthana T K "Heart Disease Prediction System using Data Mining Method", International Journal of Engineering Trends and Technology (IJETT), V47(6),361-363 May 2017.ISSN:2231-5381. www.ijettjournal.org. published by seventh sense research group

AUTHOR PROFILES:

Ms.B TRIVENI completed her M.TECH. in Amrit Sai Institute of Science and Technology Currently working as an Assistant Professor in the department of IT at DVR & DR HS MIC COLLEGE OF TECHNOLOGY(Autonomous), Kanchikacherla, NTR (Dist), AP. Her areas of interest are Data Mining, Cloud Computing and Machine Learning & Networks.

Miss.N.Devi Sri Chandana as MCA Student in the Department of DCA at DVR &DR.HS MIC COLLEGE OF TECHNOLOGY, Kanchikcherla, NTR(DT).she completed her BSC(Mscs) in BRR & GKR Chamber's degree College.Her areas of interests are Machine Learning,Python,cloud computing,Networking