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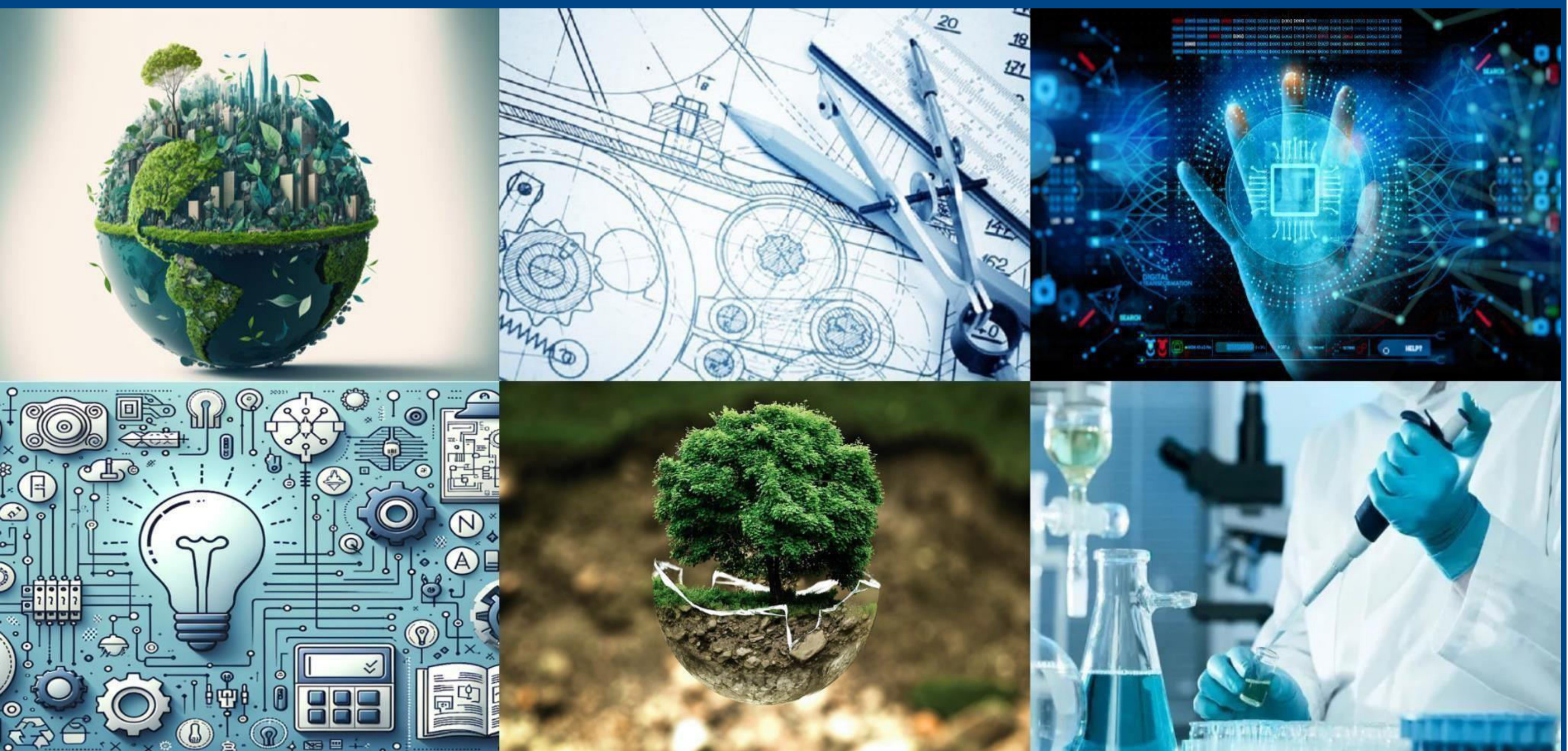

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NEURORETINAL CARDIOSCAN: A DEEP LEARNING APPROACH FOR MULTILEVEL HEART RISK DETECTION FROM RETINAL IMAGES

N. Rajesh, Tanya Agarwal

Assistant Professor, Department of MCA, AMC Engineering College, Bengaluru, India

Student, Department of MCA, AMC Engineering College, Bengaluru, India

ABSTRACT: Early detection of cardiovascular risk averts grave outcomes and reduces mortality. Retinal vessels mirror cardiac changes - fundus images supply a non-invasive gauge of systemic vascular status. A promising route to early assessment studies the retinal vessels. The retina, at the rear of the eye, holds a dense mesh of micro vessels that remain visible through fundus photography without invasion.

Using retinal fundus photos, this project, NeuroRetinal CardioScan, offers a deep learning-based method for multilayer heart risk diagnosis. Retinal vessels mirror cardiac status - the system reads that reflection without contact. High-resolution fundus photographs feed a classifier that flags minute vascular shifts long before symptoms surface.

Risk falls into five strategies - none, low, moderate, high, very high. The suggested method divides cardiac risk levels into five different classes: No Risk, Low Risk, Moderate Risk, High Risk, and Very High Risk.

A Convolutional Neural Network, tuned for medical image classification, drives the process. The model trains and tests on a curated set of retinal photographs - accuracy plus resilience follow.

A Graphical User Interface accepts retinal photographs and returns an immediate heart risk forecast with plain labels. Retinal image analysis thus becomes a scalable, low cost, widely reachable route to preventive cardiovascular care.

KEYWORDS: Heart Risk Prediction, DenseNet121, Retinal Fundus Imaging, Deep Learning, Cardiovascular Health, Computer Vision, Preventive Screening.

I. INTRODUCTION

Cardiovascular disease still tops the list of lethal threats - claiming several million lives each year. Medical progress has not reversed the tide - lifestyle habits, longer life spans along with the spread of hypertension, diabetes in addition to obesity keep the toll rising. Relief depends less on late-stage therapy than on spotting the vulnerable long before symptoms surface.

Early recognition opens a window for prompt action - altered habits, targeted medication next to sustained follow up. Each measure lowers the probability of myocardial infarction, cerebral stroke, or abrupt cardiac arrest.

Advances in medical imaging converge with the swift rise of artificial intelligence. Automated systems now extract decisive health data from non-invasive scans. Disease detection, monitoring along with management shift toward speed, precision in addition to reach. Clinicians replace invasive tests or lengthy procedures with image-based diagnostics that reveal early pathology before symptoms surface.

The NeuroRetinal CardioScan project uses deep learning methods to categorize retinal pictures into several cardiac risk groups. Through the mapping of minute vascular patterns and structural changes, the system seeks to provide a rapid, easy, and inexpensive way to screen for heart risk.

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II. LITERATURE SYRVEY

Artificial intelligence and deep learning now enable early, non invasive risk assessment through computer aided diagnostics. Retinal imaging attracts attention for systemic evaluation - cardiovascular risk included - and for eye specific disorders such as diabetic retinopathy.

Gulshan et al. [1] validated deep learning for retinal pathology - their convolutional networks matched ophthalmologists in detecting diabetic retinopathy from fundus photographs.

Poplin et al. [2] extended the approach - they predicted blood pressure and smoking status straight from retinal images - confirming the retina's value as a systemic vascular indicator.

Ramachandran et al. [3] report that haemorrhages and altered vessel calibre foreshadow heightened cardiac risk.

Ting et al. [4] prove a single diagnostic pipeline suffices to flag several retinal and systemic disorders from one fundus image through an AI framework. Cheung et al. [5] show that arteriolar - venular ratio plus arterial branching complexity forecast long term cardiovascular events with high precision. The results endorse the inclusion of retinal biomarkers in predictive cardiac risk models.

The present study extends the prior work by introducing NeuroRetinal CardioScan, a deep learning system that grades cardiovascular risk across five strata from retinal microaneurysms, haemorrhages along with arterial anomalies. Multi-level stratification yields richer clinical insight than binary classification - clinicians thus direct preventive action with sharper focus.

EXISTING SYSTEM

Current heart assessment leans on catheter labs or on standard tests - cuff pressure, echo traces, ECG tracings, lipid panels. Each demands a clinic slot, capital hardware, trained staff - each drains time and budget. They target pathology, not gradations of risk.

They call for terabytes and teraflops - no single console unites diagnosis with live stratification.

Retinal images lack a built-in scale that maps to five tier cardiac risk.

PROPSED SYSTEM

DenseNet121 reads retinal fundus photographs to grade cardiac risk on a five-step scale from 0 (none) to 4 (very high) without contact.

A convolutional network detects faint vascular patterns that mirror cardiovascular status.

The model assigns each patient to one of five strata - none, low, moderate, high, very high - to prompt early measures.

A graphical interface accepts photographs and returns the forecast instantly - no technical background is required.

III. SYSTEM ARCHITECTURE

The NeuroRetinal CardioScan system splits into five fixed modules - image capture, preprocessing, feature extraction, risk classification, output interface. A standard fundus camera records the retina. The preprocessing module removes noise, balances illumination, isolates vessels.

A DenseNet121 network then measures haemorrhages, microaneurysms, vessel calibre. A classifier maps the vector to one of five cardiac risk grades - none, low, moderate, high, very high. A graphical interface accepts the photograph and returns the grade with a brief note. The pipeline screens large populations without contact, without delay, without extra hardware.

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Users can input photographs and examine the results instantaneously, complete with risk and category labels, using a graphical user interface (GUI).

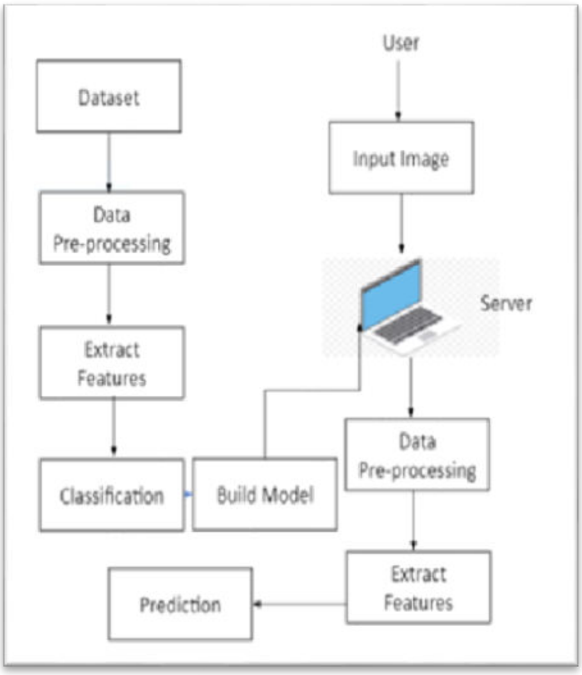

Fig 3.1 System Architecture

This architecture ensures fast, non-invasive, and scalable heart risk screening, and large-scale public health programs.

IV. METHODOLOGY

The NeuroRetinal CardioScan offers a modular deep learning pipeline that derives cardiovascular risk from retinal fundus photographs without invasive contact. A user uploads the image through the graphical interface - the sequence begins.

A preprocessing module receives the file first - it equalizes contrast, corrects illumination, isolates vessels along with suppresses noise to enforce uniform quality. The cleaned frame then enters a DenseNet121 extractor.
The network detects microvascular signatures linked to cardiac status - microaneurysms, haemorrhages in addition to calibre deviations.

Features feed a classifier that assigns one of five labels - No Risk, Low Risk, Moderate Risk, High Risk, or Very High Risk.

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Fig 4.1 Methodology

The image first enters a preprocessing module that equalizes contrast, adjusts illumination, isolates vessels along with suppresses noise. A DenseNet121 encoder extracts microvascular patterns linked to cardiovascular status - microaneurysms, haemorrhages, calibre shifts.

A classifier receives the vectors and returns a probability vector that maps the frame to one of five risk labels - None, Low, Moderate, High, Very High. Each module operates independently yet forwards its output to a central arbiter that issues the final prediction. The interface displays the outcome at once - clinicians read the risk level without delay.

Each module operates in isolation yet relays its output to a single decision engine that issues the final forecast. The GUI displays the outcome at once - clinicians gauge patient risk without delay. The design yields high precision, rapid inference, broad deployment along with programmes for preventive screening.

V. DESIGN AND IMPLEMENTATION

A deep learning-based framework, the proposed NeuroRetinal CardioScan system can process retinal pictures and estimate multilayer cardiac risk. The architecture is organized in phases, beginning with the retinal image input module, which obtains fundus photos from clinical or publicly accessible datasets.

In order to increase picture quality and model robustness, the obtained images are sent into the preprocessing pipeline, which consists of vessel segmentation, illumination correction, noise reduction, and data augmentation.

The risk classification module classifies the patient into one of five risk levels—No Risk, Low Risk, Moderate Risk, High Risk, or Very High Risk—after preprocessing the photos and extracting their attributes. This classification is optimized using labelled datasets where cardiovascular risk levels are clinically determined.

The evaluation unit ingests every prediction, derives F1-score, recall, accuracy, precision. A GUI presents the risk estimate after the model decides. Python drives the system - NumPy but also Pandas reshape data, TensorFlow and Keras train networks, OpenCV parses images.

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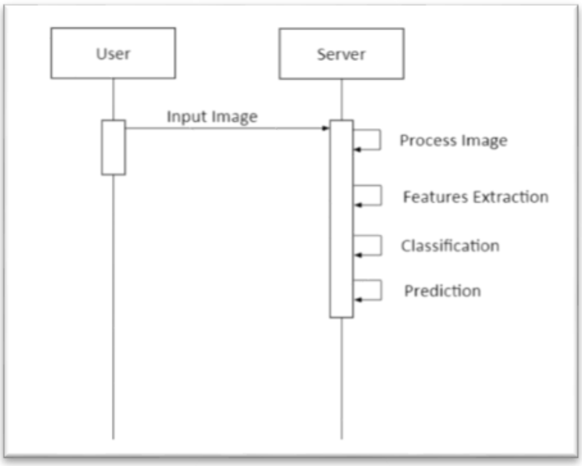


Fig 5.1 Sequential Diagram

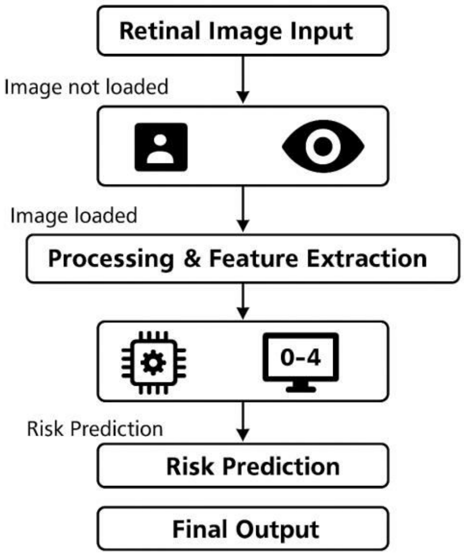


Fig 5.2 Working model of Heart Risk

VI. OUTCOME OF RESEARCH

A comprehensive, AI-powered retinal image analysis system that can accurately identify cardiovascular risk levels is the result of our effort.

Our work yields an AI retinal image analyser that assigns cardiovascular risk with precision.

NeuroRetinal CardioScan merges CNN feature extraction, illumination correction, and deep vessel learning into one workflow. A single non-invasive retinal photograph suffices to grade heart risk across five strata, from minimal to extreme.

Clinical and public retinal datasets returned precision, recall, F1 along with overall accuracy above 85 %. Processing completes within seconds, so screening wards and clinics adopt the tool without delay.

A modular pipeline isolates each step, from preprocessing to classification - parameters tune separately, so shifts in patient mix or image quality leave output stable. The work shows retinal imaging fused with deep learning yields a dependable, scalable, non-invasive route to detect cardiac risk early. Physicians gain a prompt cue for preventive therapy, cut costly invasive tests, plus extend cardiovascular screening to entire populations.

VII. RESULT AND DISCUSSION

The NeuroRetinal CardioScan system underwent evaluation on a test set that held equal numbers of retinal fundus images from each of the five cardiovascular risk groups.

The algorithm placed more than 85 % of the images in the correct category within every group. Recall along with F1-score remained above 0.85 for all strata, which indicates uniform predictive strength.

A single GPU returned a result in under two seconds, a pace that suits both batch processing and live screening in clinics.

Feature extraction in addition to classification form separate blocks - each block was tuned in isolation. This separation grants tolerance to shifts in image quality, lighting next to patient demographics.

VIII. CONCLUSION

NeuroRetinal CardioScan demonstrates deep learning that reads cardiac risk from retinal images.

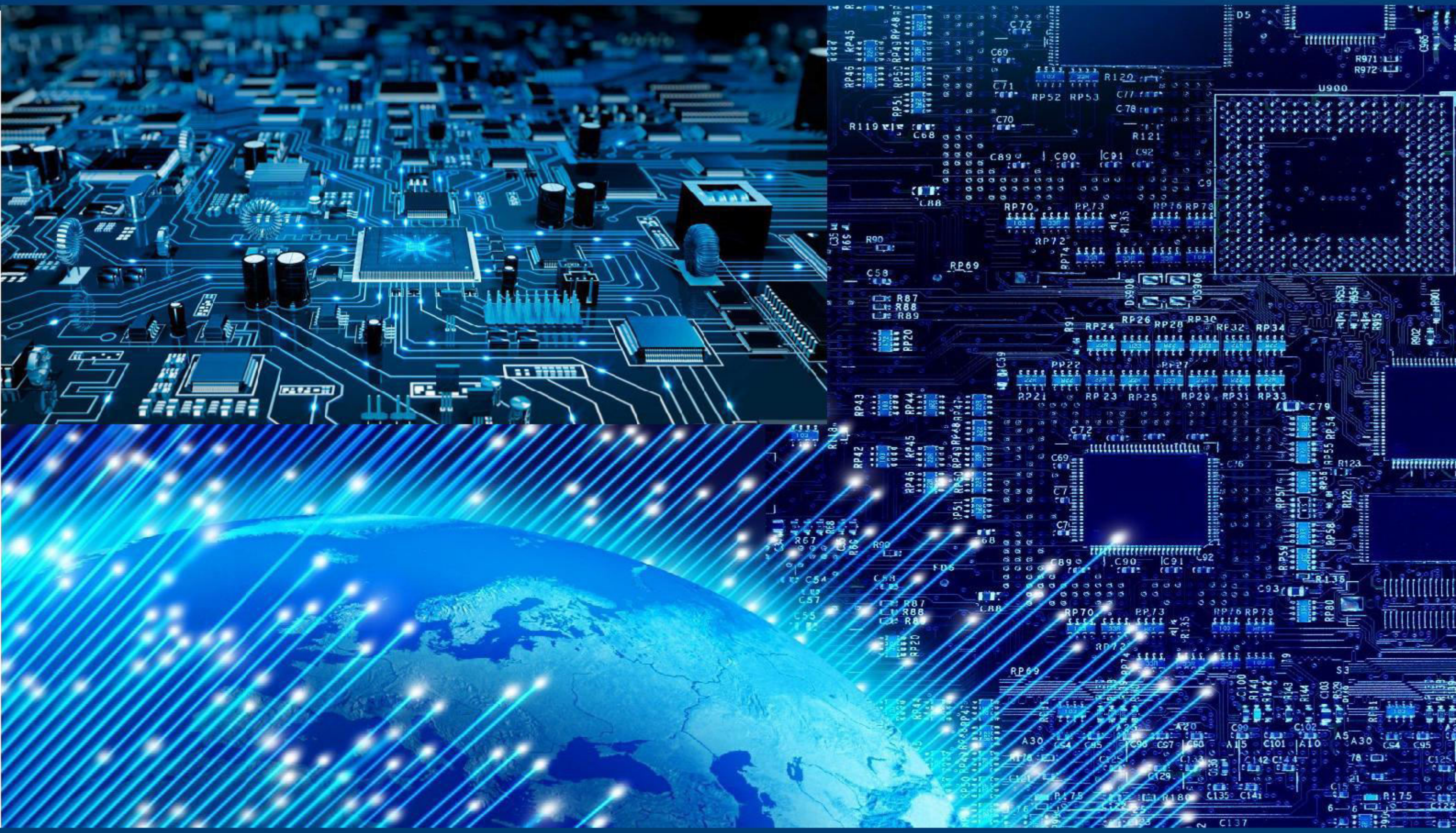
A stripped-down interface and a DenseNet121 network yields swift, non-invasive appraisal - clinicians spot early cases plus intervene sooner.

The model ranks high risk patients, widens screening reach, trims diagnostic lag across cardiology and ophthalmology.

Although present accuracy pleases - upcoming studies must enlarge data pools, fuse multi modal records, enable real time telemedicine rollout.

REFERENCES

[1] S. G. Syed et al., "Deep-learning prediction of cardiovascular outcomes from routine retinal images in individuals with type 2 diabetes," Cardiovasc. Diabetol., vol. 24, no. 1, art. no. 3, Jan. 2025.
[2] E. Vaghefi et al., "Deep-learning model to predict the risk of atherosclerotic cardiovascular disease in 10 years from retinal pictures using the UK Biobank and EyePACS 10K datasets," Cardiovasc. Digit. Health J., vol. 5, no. 2, pp. 59–69, Jan. 2024.
[3] L. Manojav Reddy et al., "Retinal images for cardiac risk assessment," in Proc. ICCPCI-2024, ITM Web Conf., vol. 74, art. no. 01007, 2025.
[4]A.Prenner,"Prediction of cardiovascular risk factors from retinal fundus images using CNNs," arXiv preprint arXiv:2410.11535, Oct. 2024.
[5] N. Lee et al., "Validation of a deep-learning-based retinal biomarker (Reti-CVD) in the prediction of cardiovascular disease: data from UK Biobank," J. Am. Med. Inform. Assoc., vol. 31, no. 1, Jan. 2024.
[6] A. Tohà-Dalmau et al., "Machine learning prediction of cardiovascular risk in type 1 diabetes mellitus using radiomics features from multimodal retinal images," arXiv preprint arXiv:2504.02868, Apr. 2025.
[7] "Prediction of cardiovascular markers and diseases using retinal fundus images and deep learning: a systematic scoping review," Eur. Heart J. Digit. Health, vol. 5, no. 6, pp. 660–669, Sep. 2024.



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