Automated Hypertension Detection Using Convolutional Neural Networks

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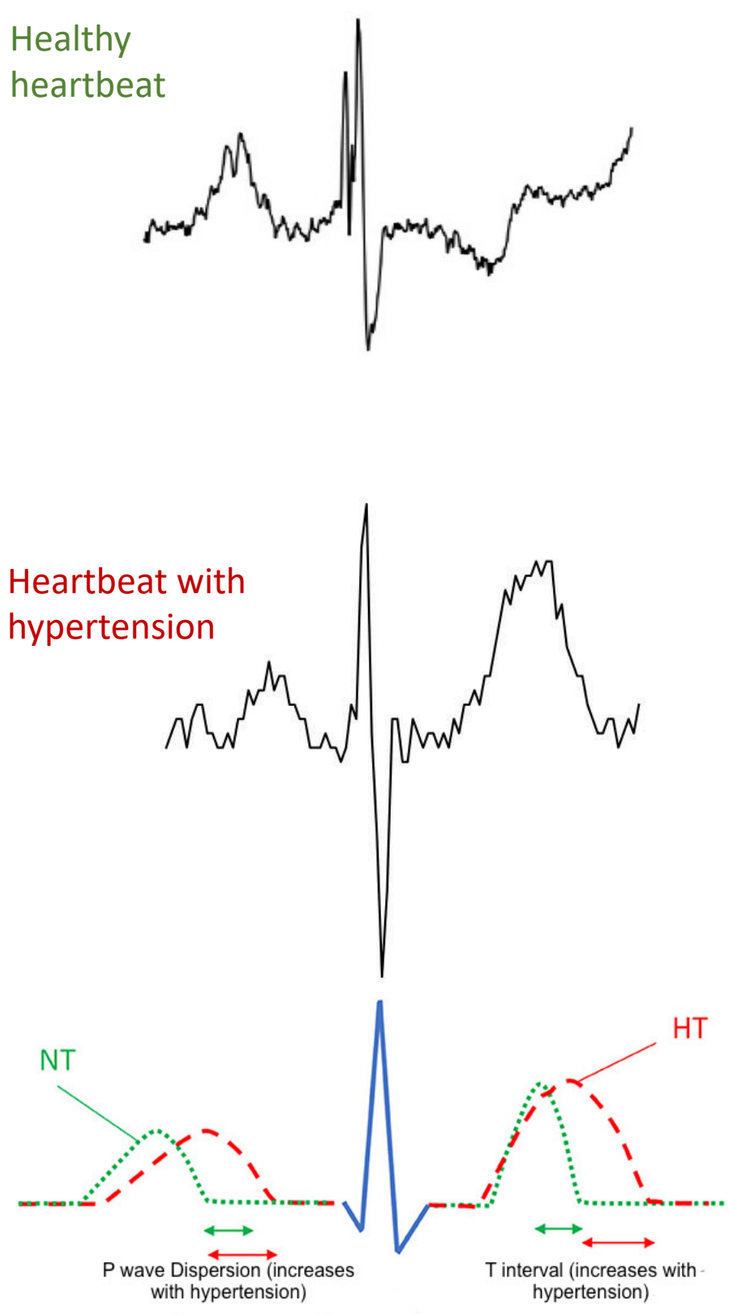


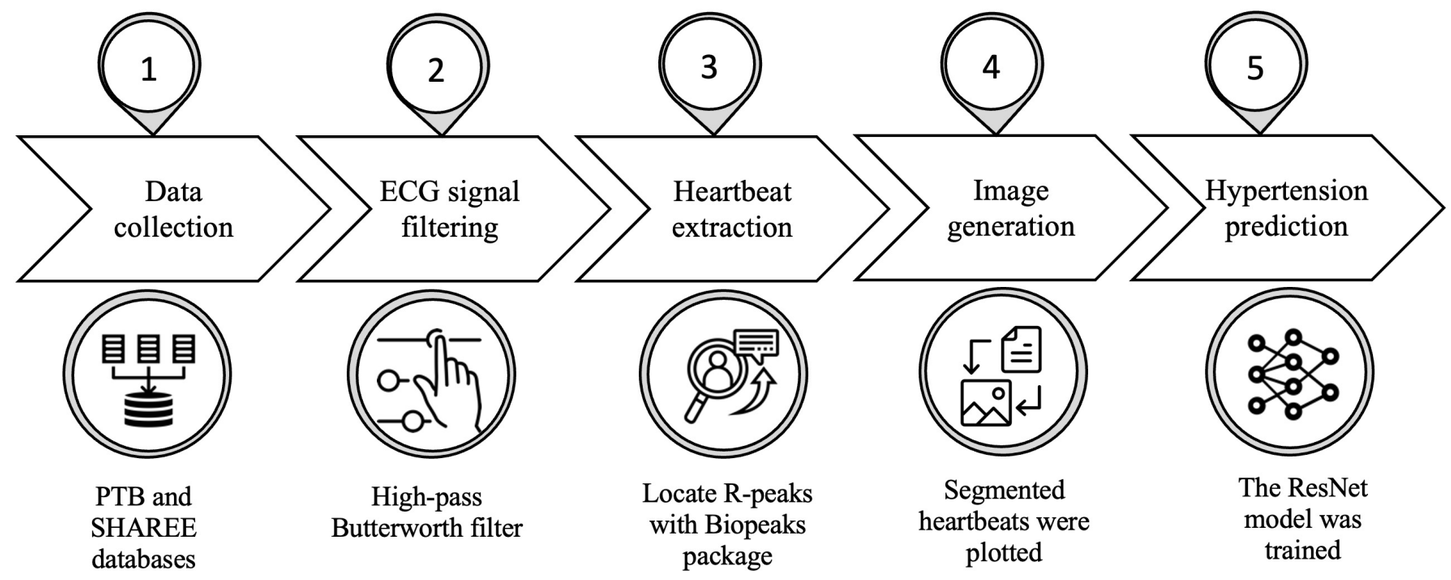
ABSTRACT

Cardiovascular diseases, notably hypertension, pose a significant threat to global public health, contributing substantially to mortality rates. Timely diagnosis and intervention are crucial in preventing the adverse consequences of heart disorders, including damage to vital organs. The primary objective of this study is to develop a robust ECG-based methodology for heart disease detection and classification, with a specific focus on distinguishing between hypertensive and healthy patients. The ECG signals were carefully prepared by removing noise, and correcting baseline wander. Furthermore, the heartbeats were automatically identified and isolated from the ECG signal data. These segmented heartbeats were plotted on a 480x480px image and classified using Convolutional Neural Network (CNN).

PROJECT DESCRIPTION

The aim of this study is to create a hypertension prediction algorithm which utilizes image of a single ECG heartbeat. Algorithm is inspired by multi-lead ECG heartbeat classification method which is based on HOG (histogram of oriented gradients) local feature descriptor [1].

WORK FLOW



RESULTS

In this study, the open-source SHAREE and PTB databases were utilized, which include 139 hypertensive and 52 healthy patients respectively. After signal high-pass filtering, more than 7000 heartbeats were extracted, and images created. The ResNet-based CNN architecture with 50 neural network layers was employed. Training and validation processes were tested with 30 epochs in total. However, no improvements in accuracy score were noticed after 9 epochs. Created model was evaluated on real-world data taken from hypertensive and healthy patients. Classification model achieved 99.7% accuracy with testing data.

CONCLUSIONS

This study proposes a novel ECG-based methodology for detecting hypertensive patients that uses images of each heartbeat and classifies into two categories: with and without hypertension. It shows that it is easily implementable and capable of classifying with high accuracy.

Future researches should include real-time model testing or include wider range publicly available databases. Furthermore, the further exploration in different ECG wave abnormalities should also be included.

REFERENCES

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