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Enhancing Remote Healthcare: Non-Contact Heart Rate Detection Using Machine Learning Approaches

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ABSTRACT

The heart rate analysis significantly improved in the proposed work by enabling contactless heart measurement by facial video analysis. The method encompasses deep neural network (DNN) architectures with firefly optimization, which improves classification accuracy and feature selection effectiveness for heart rate prediction from facial images. The proposed algorithm contributes better performance among metrics which includes precision, recall, F-measure, and accuracy.

Keywords: Contactless measurement, DNN, firefly, heart rate detection

INTRODUCTION

Health has become increasingly important in recent years. The COVID-19 pandemic served as a reminder for a regular health checkups and consistent monitoring. One of the indicator of health is heart rate which can be measured accurately and without physical contact with the body using a non-contact heart rate measurement. In this study, a video magnification technique is used to focus on face forehead which is used to detect heart rate without direct contact the individual.

RELATED WORK

Du et al. (2020) combined facial expression analysis with heart rate to present a non-contact technique to identify emotions in interactive gaming environment. Huang et al. (2020), offered a remote photoplethysmography based heart rate monitoring system for drivers in real world scenario. Song et al. (2020) presented a spatiotemporal representation technique to predict heart rate from face images using convolutional neural networks (CNNs). Zheng et al. (2022) used

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CNNs and eye position data to predict heart rate. The study by Ganesh and Nithiyanantham (2022)provided a deep learning heuristic-based channel selection for (WBANs)-based heart disease prediction. Pagano et al. (2022) provided methods to measure heart rate from the different captured parts of the face using machine learning models. Zeng et al. (2022) presented detection of heart rate method using Support Vector Machines (SVM) based on video imagery. Li et al. (2023) estimated heart rate using multi-hierarchical convolutional networks combined with a non-contact photoplethysmography (PPG) signal.

PROPOSED WORK

The proposed work includes two stages: Face extraction in the first stage and facial features analysis in the second stage, as illustrated in Figure 1.

Dataset

Eulerian Video Magnification Dataset (MIT)

The Massachusetts Institute of Technology (MIT) provides Eulerian Video Magnification Dataset, which comprises 100 video of heart rate recording.

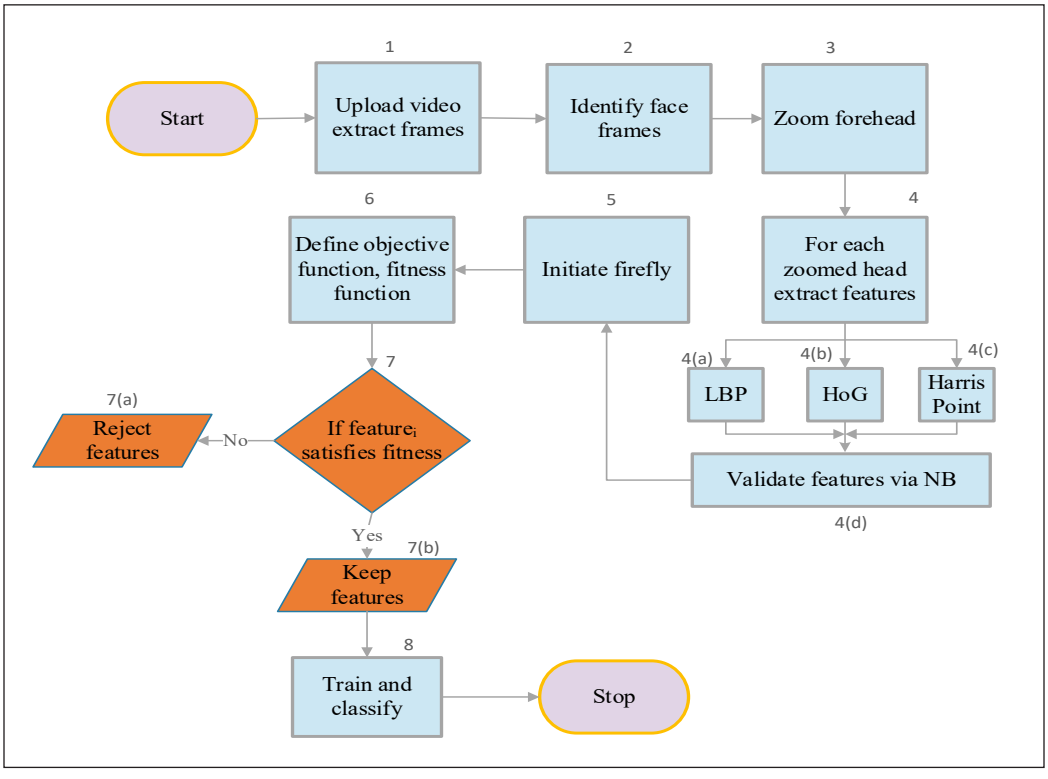

Figure 1. Workflow of video magnification technique

Real Time Dataset

A custom dataset with a video in real time was generated to evaluate the effectiveness and validation of the proposed work.

RESULTS AND DISCUSSION

The evaluation was conducted on two distinct datasets which mentioned in previous section to make our findings more robustness and general. By integrating Firefly optimization with DNN in the proposed work, the precision values exhibited superior precision score, Recall value and F-Measure. The graph highlights the algorithm's overall high in accurately classifying instances across all classes in the dataset.

CONCLUSION

The video magnification technique achieved the Precision score of 90.22%, recall score of 94.46%, F-measure of 92.26%, accuracy score of 83.92%. These results indicated effectiveness of the proposed approach in feature selection and classification operations.

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