ANSWERS TO THE REVIEWERS' COMMENTS

First of all we would like to thank the editors and the reviewers for their work and valuable comments on the manuscript, which hopefully helped us enhance it in this revised version. We updated the manuscript to introduce all the suggested modifications and better clarify critical aspects. For the reviewers' convenience, we provide a detailed answer to the specific comments.

ID	Reviewer's comment	Answer
Reviewer #2		
1-1	what he problem with the modern state of the art solutions. The method demonstrate the same performance metrics as the best modern solution - why and where it can outperform them significantly to be important for the users of PPG technology.	Thank you for the comments. Our method was compared with five existing PPG peak detection methods using different noise levels (i.e., from noise-free PPG signals to distorted PPG signals due to high level of noise). Our findings showed that the performance of all the methods was similar in noise-free conditions: i.e., when the SNRs are higher than 40 dB. The noise-free signals include no or a few false peaks, and the methods could detect the systolic peaks successfully. However, in real-life situations, the PPG signals, collected by wearable devices, might be distorted (including false peaks) due to motion artifact or environmental noise. With the medium noise level signals (i.e., SNRs from 40 to 15 dB), our method outperformed the state-of-the-art methods. As shown in Figure 14, the precision and F1-score of the proposed method are higher than the other methods' values. The recall value of the proposed method is higher than all the other methods' recall values and is similar to the 1D-CNN method recall. With the high noise level signals (i.e., SNRs less than 15 db), the performance of all the methods (including the proposed method) were diminished. However, the results showed that our method were more successful with low quality signals as well. We updated the test set results section in the manuscript accordingly.
1-2	The influence of noize is investigated, but more information should be provided concerning what is the typical noize levels and in which cases (what % of overall cases) the proposed method outperform the best solution and provide more reliable result	The PPG method is widely used in wearable and mobile applications. However, the collected signal is highly susceptible to noise. The typical PPG noises include motion artifact, baseline wander, and environmental noise [1]. The noise level in the PPG signal depends on different factors, such as the sensor quality, sensor setup (e.g., electric current), intensity of the activity, and environmental factors (e.g., ambient light) [2]. In this paper, we focus on the noise levels in PPG signals. We have updated Section 2.1. (Photoplethysmography) by adding the existing different noise types in PPG signals and the origin of these noise types. As described in Answer 1-1, our method considerably outperforms the other methods when the noise level is medium (i.e., SNR ranges from 40 to 15) and noise level is high (i.e., SNR less than 15). With 40 to 15 SNR values, the proposed method F1-score is between 94% to 78%. However, the other methods F1-score values are between 93% to 64% (please see Figure 14). As mentioned previously, with 10 to 0 SNR values, the performance of all methods is low, but the proposed method performed better compared the state-of-the-art methods.

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ID	Reviewer's comment	Answer
1-3	The review part looks very short for such common task and probably should be extended.	Thank you for the comment. We present the related work in Section 3. We first describe different filtering methods proposed for noise removal in PPG applications: e.g., low-pass, band-pass, high-pass, adaptive filter, and singular value decomposition methods. We then outline the adaptive threshold-based technique used for PPG peak detection. Then, transform-based techniques, such as Hilbert and wavelet transform, proposed for PPG peak detection are discussed in Section 3.2.2. Moreover, traditional machine learning and deep learning methods in the context of PPG and ECG peak detection are presented in section 3.2.3. To address this comment, we extended the Related Work Section and included studies on this topic – accepted/published recently. In this regard, we added two new studies on Hilbert Double Envelope [3] and window-based PPG peak detection method [4] to Section 3.2.2. Moreover, a novel two-step method for noise removal [5] has been added to Section 3.1. Also, the Introduction Section has been updated accordingly.

References

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[2] Anzanpour, A., Amiri, D., Azimi, I., Levorato, M., Dutt, N., Liljeberg, P. and Rahmani, A.M., 2020. Edge-assisted control for healthcare internet of things: A case study on ppg-based early warning score. ACM Transactions on Internet of Things, 2(1), pp.1-21.
[3] Esgalhado, F., Batista, A., Vassilenko, V., Russo, S. and Ortigueira, M., 2022. Peak Detection and HRV Feature Evaluation on ECG and PPG Signals. Symmetry, 14(6), p.1139.
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[5] Heo, S., Kwon, S. and Lee, J., 2021. Stress detection with single PPG sensor by orchestrating multiple denoising and peak-detecting methods. IEEE Access, 9, pp.47777-47785.