Dear Editor,

The manuscript has been revised according to the suggestions and comments of the reviewers. I appreciate the reviewers' comments, which helped me to revise the manuscript. Please kindly note that two new figures have been added and major revised parts are highlighted in red color for your convenience of re-reviewing.

The responses to the specific comments of the reviewers are as follows:

Reviewer #1:

1- The abstract should be revised by adding concrete results that the author has found from the described model.

Done.

Experimental results showed that the proposed method was able to detect cardiovascular events with better performance (95.30% average sensitivity and 95.94% mean prediction values).

2. I agree with the first reviewer that this study is lacking of clear description of the methodology (where the data come from, the size of the population that the data come from, the author cited that there were data collected from different ages and genders: more specification about these parameters would be requested for better understanding whether there is age dependency CVD and COVID association) and how the IoT has been applied to test the hypothesis in this study.

In the research methodology section (3 Proposed Health Monitoring System), Figure 1 (Architecture of the IoT for ECG monitoring) has been added. ECG data are gathered using a wearable monitoring node and are transmitted directly to the IoT using Wi-Fi. Both the HTTP and MQTT protocols are employed in the IoT in order to provide visual and timely ECG data to users using REST service. For evaluation, the UCI cardiac arrhythmia dataset was used, that contains 452 ECG signals of different people of different ages and genders. This is the data specification that is collected on the IoT platform.

All sensors receive ECG signals from the body and transmit them to the IoT environment via a WiFi module. The IoT environment includes two types of HTTP and MQTT servers. The HTTP server is used to provide a graphical user interface, and the MQTT server is used to transmit ECG signals. Unlike HTTP, the MQTT protocol is used for long-term, real-time communication. With this approach, a patient's ECG signals are instantly received through a web browser; they are automatically analyzed. A warning alarm is sent to the doctor, patient, or those around him if a cardiovascular event is detected.

3- The conclusion has to be revised because it lacks the significant outcomes of the study.

Done.

The experimental results showed that the proposed RST-LSTM model outperform all other models on the level of average PPV (with 96.77% value), average NPV (with 95.12% value) and average sensitivity (with 95.30% value) performance measures, which confirms the superiority of our model. Finally, we can conclude that the RST-LSTM model provides a greater performance improvement than several state-of-the-art models.

Minor points: Section 3, there are two parts having the same title, please correct.

Done.

Reviewer #2:

1. The abstract should be revised by adding some numerical results for the model evaluation measures.

Done.

Experimental results showed that the proposed method was able to detect cardiovascular events with better performance (95.30% average sensitivity and 95.94% mean prediction values).

2. In the research methodology section is not clear how the IoT technology has been used. The author should revise the methodology section by adding an illustration /framework shown the how IoT has been employed in the proposed research.

In the research methodology section (3 Proposed Health Monitoring System), Figure 1 (Architecture of the IoT for ECG monitoring) has been added. ECG data are gathered using a wearable monitoring node and are transmitted directly to the IoT using Wi-Fi. Both the HTTP and MQTT protocols are employed in the IoT in order to provide visual and timely ECG data to users. For evaluation, the UCI cardiac arrhythmia dataset was used, that contains 452 ECG signals of different people of different ages and genders. This is the data specification that is collected on the IoT platform.

All sensors receive ECG signals from the body and transmit them to the IoT environment via a WiFi module. The IoT environment includes two types of HTTP and MQTT servers. The HTTP server is used to provide a graphical user interface, and the MQTT server is used to transmit ECG signals. Unlike HTTP, the MQTT protocol is used for long-term, real-time communication. With this approach, a patient's ECG signals are instantly received through a web browser; they are automatically analyzed. A warning alarm is sent to the doctor, patient, or those around him if a cardiovascular event is detected.

3. Section “3.2 Classification with LSTM and section 3.3 Classification with LSTM” have the same heading title. Please check and revise accordingly.

Done.

4. In section 3.3, the authors show the typical Structure of an LSTM memory unit, what about your own proposed LSTM model structure? What has been used to avoid vanishing gradient problems in LSTM?

5. Is there any optimization or hyperparameter selection method used?

In this paper, the classic LSTM architecture was used, that is characterized by a persistent linear cell state surrounded by non-linear layers feeding input and parsing output from it. Concretely the cell state works in concert with a forget gate (f_t), an input gate (i_t) and an output gate (o_t). The structure of the classic LSTM is shown in Figure 3.

In general, the classic LSTM performs about as well as the newer (e.g. the GRU) variants, and continues to achieve state-of-the-art results on a variety of cutting-edge tasks over many years later. Actually, paying attention to details like bias initialization is more important than the elaborate architecture used. The researchers found that by initializing the forget gate with a large bias term they saw significantly improved performance of the LSTM. This bias is important to avoid diminishing the forget gate with a vanishing gradient, a naive initialization with small random vsalues and sigmoid activation leads to forget gate values centered around 0.5 that will rapidly attenuate the ability to learn long-term dependencies.

6. A comparative analysis section must be added before the conclusion to compare the proposed models in this study with the related literature review contributions based on UCI cardiac arrhythmia benchmark dataset.

For further experiments, several another state-of-the-art studies [14], [31] and [32] have been investigated, where the performance of the proposed approach compares favorably with those approaches. The experimental results are shown in Figure 4.

7. The reviewers checked the whole manuscript, and he could not find the limitations of the proposed system/framework.

The final goal of the automated analysis of ECG signals is to be implemented as a practical medical diagnostic tool in large-scale clinical settings. For this purpose, it is necessary to augment the practicality of algorithms by improving both their accuracy and computational efficiency/complexity. Therefore, the complexity of proposed method is a critical point that needs to be addressed in future studies. However, some researchers compared the complexity of LSTM with some other algorithms and showed that computational efficiency and memory were increased by LSTM in comparison with competing algorithms, although LSTM provided higher accuracy.

Therefore, there is still a need to investigate how to best improve the efficiency of algorithms to fill the gap between the academic and practical uses of deep learning approaches. It is also critical to find an efficient algorithm that satisfies the time and memory requirements for practical usage of cardiovascular event prediction. Evaluating the performance and computational efficiency of the proposed method on very large datasets (big data) is considered as one of the future works, so that the proposed method can be tested in parallel or distributed platforms.

Future work can also focus on data collection and analysis of health care systems for the development of any specific desired tasks such as sleep stage classification, seizure detection, stress detection and emotion recognition to save time and effort that would otherwise be needed to design a specific algorithm for each task. In the proposed approach, the trial and test method was used for network parameters setting, in which Metaheuristic algorithms could be used to improve the work.

Another limitation of this research is that since the field is new, standards of experimentation and evaluation have not yet been established. This makes it difficult to draw clear conclusions when comparing studies that might even be investigating the same conditions. Furthermore, these mathematically-focused contributions do not always control for physiological variables when collecting data simultaneously from multiple and heterogeneous sources. This issue is further exacerbated by the relatively a small amount of data that are typically used for these experiments, and a lack of sufficient details when reporting on how the data were collected.

Since all the corrections have been made, we hope the manuscript will now be accepted without any further changes. We look forward to hearing from you regarding our submission. We would be glad to respond to any further questions and comments that you may have.

Sincerely yours,

Sina Dami, PhD