

Response to Reviewer 3 Comments

In this paper, author presents the classification of EMG signal based on Light-Weight Neural Network classifier. The signal processing and the classification algorithm are implemented using FPGA technology.

This is an interesting work, however, I have some comments and remarks.

Point 1: - Abstract needs to be rewritten to understand the summary of the work done highlighting the principal contributions.

Response 1: In my opinion, Abstract seem to reflect all the experimentation well enough. Instead, I modified "Conclusions and Discussions" part for better understanding.

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The main contribution of this study is that the practical application using edge devices are examined. However, in order to be grafted onto wearable devices, it must be implemented with smaller resources. For future studies, the wearable system with bio-signal sensor system and the edge device will be manufactured together. This system will help the self-diagnosis at the user's desired time. Also, the studies on Siamese networks or Ensemble networks that can learn with little data are also planned to be added. At the same time, it plans to manufacture PPG and ECG sensors to build a wearable system based on artificial intelligence.

Point 2: - In the introduction, the comparison with previous works must be more precise in order to highlight the real contribution of this work. In addition, the motivation and

background of wide practical use of the theoretic results presented should be clearly emphasized to facilitate the readers.

Response 2: I added the recommended references in "Introduction".

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This is amplified by the differential amplification unit to determine muscle movement [10].

Point 3: - Some figures are not clear. Please provide a high-resolution figure and check the selected colors.

Response 3: For clear understanding, all figures have been rearranged and modified.

Point 4: - English is generally good, but needs to be polished further. The manuscript should be formatted better and some spelling and grammar should be checked carefully.

Response 4: I modified the following sentences for better understanding.

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In [15], based on the EMG signals measured in 16 channels, support vector machine (SVM) and generalized regression neural network (GRNN) artificial intelligence algorithms were used using root mean square (RMS), autoregressive model (AR), and slope sign change (SSC).

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In the case of the EMG input dataset, since the number of datasets is small, it is not suitable for training. Therefore, data augmentation was implemented using additive noise and magnitude warping techniques.

Point 5: - The selection of the related useful feature extraction approaches should be more discussed. How the authors chose these approaches only based on the literature? I think that it's better to test some features and select the more suitable approaches.

Response 5: I added the sentences following to the Reviewer's comments.

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The MODWT method is expanded while preserving the size of the data. There are various researches related to feature extraction [38]. Based on the dataset measured at Chosun University, it was confirmed that the scalogram based on CWT (continuous wavelet transform) is useful as an ECG feature [39]. By extending this, MODWT was selected as a feature suitable for EMG analysis at edge devices.

Point 6: - Muscle selection and electrode placement should be more detailed and justified.

Response 6: I added the sentences following to the Reviewer's comments.

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Figure 1(a) shows a prototype of the EMG sensor currently under development. A differential amplifier was used, and signals from 10 Hz

to 250 Hz were obtained using frequency filtering. Figure 1(b) shows the measured EMG signal in the wrist. In the future, it will be produced in the form of a wearable watch through miniaturization and low power consumption, and it will be combined with an edge device for artificial intelligence to detect wrist movements.

Point 7: - The selection of the sampling frequency should be justified (Shannon theory). I think that 500hz is too low for accurate signal reconstruction.

Response 7: The sampling frequency of the dataset is 500 Hz, but the future EMG sensor will be manufactured with a higher sampling frequency.

Point 8: -What kind of filter has been used (IIR?) for EMG preprocessing ?

Response 8: EMG preprocessing is performed with an FIR filter.

Point 9: - Experimental platform is missed. EMG sensor, electrode types, acquisition system and other components should be presented and discussed.

Response 9: In short, I added the prototype EMG sensor system in Figure 1.

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Figure 1. (a) Prototype for EMG sensor, and (b) the measurement results in the wrist.

Point 10: - Discussion part is missed, it should be added. Conclusion does not reflect the presented work. It should be rewritten by adding the limitations and perspectives.

Response 10: I modified "Conclusions and Discussions" part.

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The main contribution of this study is that the practical application using edge devices are examined. However, in order to be grafted onto wearable devices, it must be implemented with smaller resources. For future studies, the wearable system with bio-signal sensor system and the edge device will be manufactured together. This system will help the self-diagnosis at the user's desired time. Also, the studies on Siamese networks or Ensemble networks that can learn with little data are also planned to be added. At the same time, it plans to manufacture PPG and ECG sensors to build a wearable system based on artificial intelligence.

Point 11: Concluding, the whole paper is a combination of existing technologies without any real contribution, any real photo showing the experiment !

Response 11: This study is currently in development. So, the EMG sensor is not currently being used, so the content may seem lacking. EMG sensor will be supplemented in the future to build a dataset. The main content of this paper is to check if EMG sensor and edge device for artificial intelligence can be manufactured as a wearable system. To this end, a neural network with a simple structure with few parameters is proposed. It is very difficult to secure high accuracy with few parameters, so it would be good if the originality of this was acknowledged. In this regard, research on Siamese networks and

Ensemble networks is underway, so it seems that better papers can be found in the future. I would appreciate it if you could understand it as a transitional paper for practical application.