

Murmur Classification with U-net State Prediction

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ABSTRACT

Background and Objective: Heart sounds are recorded which is known as phonocardiography (PCG). However, characteristic of PCG and influence of noise, the detection and classification of PCG are challenging. Generally, murmur is detected in systolic or in diastole state. Our team predicted four states of PCG and classified heart sound into three classes that are absent, present, and unknown.

Methods: PCG signals were denoised by Butterworth filter and spike removal method and then segmented into 4096 samples. S1, systolic, S2, diastole state was predicted by U-net model. The results of U-net prediction were used as features along with the denoised PCG signal for classification. Considering the murmur locations, from the result of U-net model S1 and S2 state were replaced with zeros. Transformed denoised PCG signals were classified by ResNet multi-classification method.

Results: U-net accuracy of predicting four states of heart signal was 0.97. The mean squared error (MSE) score was 0.02. Moreover, standard deviation of systolic and diastole were 39ms and 61ms respectively. Our team MainLab's challenge training time and score according to the challenge leaderboard are 9 hours 46 minutes and 2172 respectively.

Conclusion: Novelty of our proposed method is that murmur is not detected randomly, our method predicts additional information. Additional information in this case would be four states of heart sound S1, systolic, S2, and diastole. And classify murmur from PCG signal combined with predicted state of PCG.

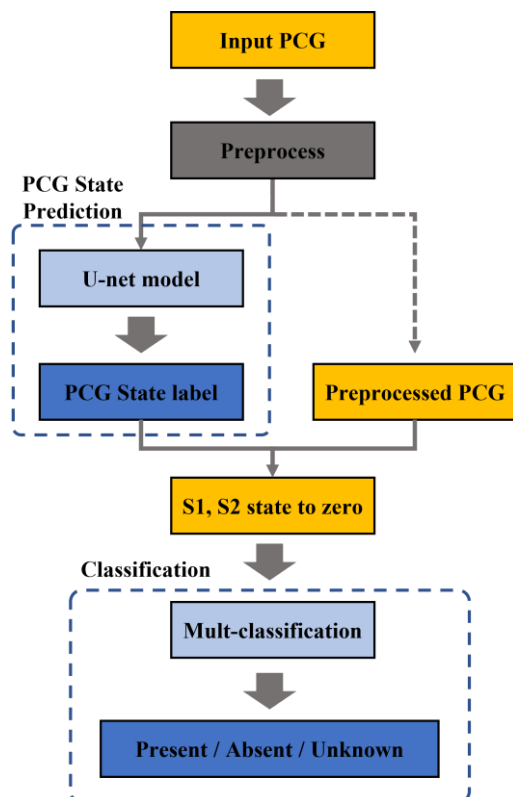


Figure 1. Model overview of proposed method.

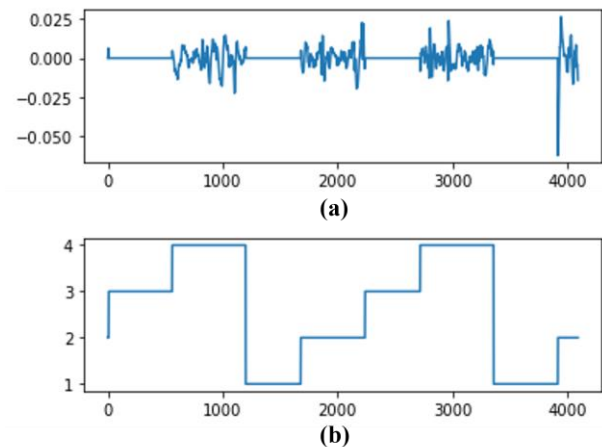


Figure 2. Result of S1 and S2 state values replaced with zeros are shown in (a). The state label is depicted in (b) where S1 is 1, systolic is 2, S2 is 3, and diastole is 4.

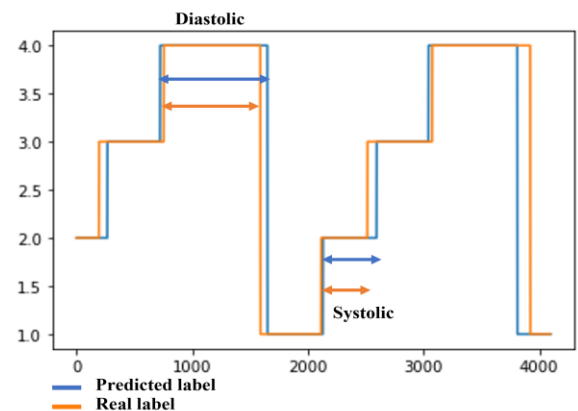


Figure 3. Result of predicted state. Blue line represents the predicted state, the orange line represents the reference state segment of heart sound.