A Faster R CNN-based Real-time QRS Detector

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Accurate QRS location keeps challenging in dynamic electrocardiograms (ECGs). Anti-interference ability of the most existing QRS detectors need to be improved. This study addressed this issue and developed a novel faster R CNN model-based real-time QRS detection algorithm. Firstly, ECGs were segmented into 10-s length episodes, and each episode was transformed into a two-dimension image with a pixel size of 256×256 (VOC2007 format). Labelled QRS location information was used to generate the QRS bounding boxes in the images. A faster R CNN model was constructed. Feature maps were generated during the model training and candidates of QRS bounding boxes were extracted by the region proposal networks (RPN). Then, candidates of QRS bounding boxes were with small probabilities were excluded according to the rules of probability distribution and QRS location relationship. Finally, locations of QRS complexes were determined based on the geometric features and threshold rule.

The proposed algorithm was trained on the MIT/BIH arrhythmia database and verified on the actually recorded 24-h wearable ECGs. Five-fold cross validation on the MIT/BIH arrhythmia database achieved a sensitivity of 99.24% and a positive predictivity of 99.90%, resulting in an accuracy of 99.08%. When tested on five 24-h wearable ECG recordings, the algorithm generated a sensitivity of 99.34%, a positive predictivity of 99.14% and an accuracy of 98.43% compared with the manual annotations. In addition, the cost time of the new algorithm for processing a 10-s ECG episode was less than 20ms under the experiments of CPU i7-2600 3.40GHz, 8GB RAM, tesla M60 GPU and 16GB graphics memory. This study verified the efficiency of the proposed faster R CNN-based real-time QRS detection method.

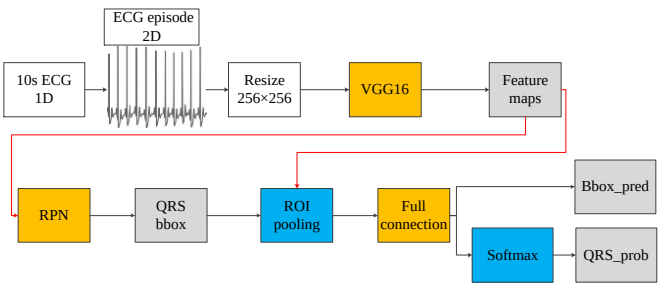

Figure. Designed faster R CNN model.