A Smart Heart Monitoring System with ECG Analysis Based on Deep Transfer Learning

Park, Jason (School: Baton Rouge Magnet High School)

In 2015, 13,000 Louisiana residents died of heart disease. Due to expensive cost of ECG analysis, underrepresented community people cannot get medical supports. There are challenges on medical datasets because it is more expensive to collect and label medical datasets than typical image datasets due to cost and patient privacy issues. Moreover, datasets collected from new medical devices are different and cannot be used for previous analysis algorithms. Therefore, it is challengeable to apply deep learning algorithms to different datasets, such as hospital grade 12-lead ECG data and cheap mobile single-lead ECG data. This project proposed a software based on a noble deep transfer learning algorithm to analyze mobile single-lead ECG signals based on the knowledge acquired from 12-lead ECG datasets. In order to train the deep CNN model, the project used a public ECG dataset produced by MIT and Boston's Beth Israel Hospital (BIH). To transfer knowledge from 12-lead data to mobile ECG data, the project has two-step training: 1st step pre-training with a 12-lead public ECG dataset (MIT-BIH) and 2nd fine-tune training with a single-lead ECG dataset (Alivecor). The experiment results showed that the developed approach's accuracy results, such as precision and recall, are better than the accuracy results of Cardiologists. Furthermore, the experiment results showed that the accuracy results are higher than those of the previous works (e.g., Stanford University). In conclusion, the project showed that the proposed Smart Heart Monitoring System with ECG Analysis based on Deep Transfer Learning has a potential to help under-represented community with low cost and high accuracy of prediction.

Awards Won: