Detecting atrial fibrillation via existing smartphones without any add-ons

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Declaration of Interest

- I have nothing to declare

Background

- Atrial Fibrillation (AF) occurs in approximately 2% of the global population, accounting for up to seven million strokes per year. In the European Union alone this heart rhythm disorder costs approximately USD $19 billion every year
- Up to 90% of intermittent AF episodes may be asymptomatic (”silent”) and therefore a vast number of AF cases remain unnoticed. Around 70% of strokes due to atrial fibrillation could be avoided with pre-emptive medication. Large scale screening of ”silent” AF has been proposed as a way to reduce the stroke risk from persons suffering from asymptomatic AF.
- A smartphone solution could thus provide means to screen these persons from the population. There have been relatively large and costly electrocardiogram (ECG) devices that patients can take home for long-term monitoring, but they require a patch or wires that are clumsy to use and continuous contact with electrodes tends to irritate the skin

Declaration of Interest

None

Purpose and key points about methods

- Our objective is to provide simple and cost-effective means for detecting AF (including the "silent AF").
- ECG requires additional hardware to be present when implemented on a smartphone. This creates a challenge for wide-scale screening of populations of higher risk age groups (60 years and above)
- Previously, there have been a methods to detect AF by acquiring user's heart signal from smartphone's camera illuminated by flash, while a user puts his/hers finger on the camera. The challenges related to that approach are coping with varying external illumination and changes in user's finger tip location
- In our approach, for example, if a person feels odd and want to check his/hers cardiac status, he/she can simply lie down, place a smartphone on the chest and take accelerometer and gyroscope measurement of his/hers heart signal

Results

- The acquired data is pre-processed by signal processing methods. Multiple features such as autocorrelation and spectral entropy are then extracted from the pre-processed data. Finally, a machine learning algorithm (Kernel Support Vector Machine, KSVM) is used to determine if the patient suffers from atrial fibrillation or not
- To validate our approach we included data from 16 patients suffering from atrial fibrillation from the Turku Heart Center. In addition 20 recordings from healthy volunteers were captured. The test data was used to validate the performance of the developed algorithms
- Using the test data acquired (normal rhythm vs. AF rhythm), atrial fibrillation detection with a sensitivity and specificity both of more than 95% was possible. In a future implementation a more versatile and complete set of different data could be incorporated to the same framework
- All the steps of the algorithm can be implemented as a smartphone only solution

Conclusions

- A low cost, non-invasive solution was developed to detect AF, which can be applied without the help from medical staff
- Given the widespread use of smartphones, the developed methods can scale for large populations with a potential of giving a positive impact on the cardiac health worldwide