Smart Speakers for Non-Contact Detection of Cardiac Rhythm

Assessing the rhythm of the heart is vital in treatment of a wide range of cardiac conditions or monitoring healthy patients. This innovation presents the use of commodity smart speakers as an active sonar, for non-contact detection of heart rate and inter-beat intervals (R-R intervals) for regular and irregular rhythms.

What is the Problem?

Monitoring the rhythm of the heart is crucial in the diagnosis and management of a variety of cardiac conditions, as well as to study the heart rate variability of healthy individuals. Measurement of R-R intervals, the beat-to-beat time of the heart, is typically extracted using electrocardiography (ECG). However, this approach requires contact with the skin to operate, which could cause complications in several cases. For instance, monitoring contagious patients could require burdensome cleaning of any components that come into contact, or such contact could preclude its use on patients with skin allergies or other types of intolerances to wearable devices. In addition, more easily accessible measurements of R-R intervals and heart rates could benefit the growing telemedicine field, allowing providers to get the data they need without at-home ECG equipment. A non-contact tool for measuring R-R intervals, while using commonly available sensing technologies, would solve all the above problems at once.

What is the Solution?

This innovation presents the adaptation of a smart speaker such as Google Nest or Amazon Echo devices into a short-range active sonar system capable of extracting both heart rate and R-R intervals. These devices, high quality speakers equipped with multiple microphones, are already capable of determining a user's distance through inaudible acoustic signals and analyzing resulting reflections. This innovation uses these non-audible signals and reflections to extract the motion of the chest wall and the arterial pulsations on the body surface, extracting the R-R intervals and the heart rate without making contact. Advanced data processing can separate out these signals from the breathing of the subject as well as environmental noise; to achieve low error below 30 milliseconds compared to ECG data in a clinical study.

What is the Competitive Advantage?

The advantages of this non-contact system for measurement of R-R intervals are the simplicity of its operation, and the usage of pre-existing hardware that is already owned by many people.

Technology ID

BDP 8615

Category

Selection of Available Technologies

Diagnostic

Authors

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Other methods such as doppler radar and optical vibrocardiography, on the other hand, does require specialized equipment for the same non-contact measurements. Privacy is ensured by not requiring any cameras, as well as the requirement for active participation of the user to stand still within one meter of the device. At the frequency range the technology uses, there is minimal impact from environmental sounds, further aiding in the impressively accurate measurements.

Patent Information:

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References

1. Anran Wang, Dan Nguyen, Arun R. Sridhar, Shyamnath Gollakota(44264) , https://www.nature.com/articles/s42003-021-01824-9, https://www.nature.com/commsbio/, 4, 319