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*Abstract*

# Ultralight, Compact, and Stretchable Electronics for Continuous and High-Quality Cardiac Assessment in High User Activities †

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**Abstract:** The need to monitor electrocardiogram (ECG) in continuous yet comfortable manners has propelled the development of many wearable ECG devices that could replace the roles of traditional systems, such as the Holter monitor. However, despite the reduced form factor and weight, commercially available devices rely on the use of aggressive adhesives for attachment to the skin due to the bulky and rigid electronic module as well as conductive hydrogels to acquire the biopotential. Since the adhesives and gels are known to cause skin irritation and injuries, there has been a critical need to develop a wearable system, which is both compact and safe for the user. Recently, a stretchable and dry-contact ECG device has been reported and the feasibility to continuously transmit ECG safely and reliably has been demonstrated. In this study, we report a further improvement in device weight and size of the device by implementing a two-electrode design as well as optimized power management strategies allowing for robust transmission of continuous ECG on a reduced power budget. With the device weighing just 5.2 g, ECG with a higher signal-to-noise ratio (22 dB) than the previous value (17 dB) could be obtained during excessive user movement, such as running and exercising. Along with the combination of data compression, buffered Bluetooth transmission of 1 min, and a low-power ECG front-end, continuous assessment of ECG could be achieved over 24 h, a milestone for continuous transmission of ECG, the proposed system will bring a paradigm shift in continuous cardiac monitoring.

**Keywords:** wearable electronics; stretchable electronics; electrocardiogram