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A02 Smart health and wellness

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Abstract

Cardiovascular diseases (CVD) remain the leading cause of mortality and a major cause of morbidity in Europe. Every year there are more than 6 million new cases of CVD in the EU and more than 11 million in Europe as a whole. With almost 49 million people living with the disease in the EU, the cost to the EU economies is €210 billion a year. There is a growing demand for a reliable cardiac monitoring system to catch the intermittent abnormalities and detect critical cardiac behaviors which, in extreme cases, can lead to sudden death. The objective of the Smart Autonomous Multi Modal Sensors for Vital Signs Monitoring (SmartVista) project is to develop and demonstrate a next generation, cost-effective, smart multimodal sensing platform to reduce incidences of sudden death caused by CVD, and will contribute to the EU vision of an Internet of Things for healthcare. The key innovation in SmartVista is to integrate 1D/2D nanomaterials based sensors to monitor the heart, thermoelectric energy harvesters to extract energy from the body to power the system and printable battery systems to store this energy. Together these will result in a self-powered device that will autonomously monitor the electrocardiograph, respiratory flow, oxygen flow and temperature of the patient. This information will then be transmitted wirelessly for online health processing. This real-time self-powered monitoring of a patient's health is currently not available. Thus, the technology that will be developed in SmartVista will position us at the forefront of digital health and wearable biosensor technology for wireless monitoring in hospitals and of remote patients, both of which are necessary in this era of an aging population.

Introduction

The SmartVista project aims to develop a **smart multi-modal sensing platform** for health vital signs monitoring using **1D/2D nanomaterials based sensors, on-chip thermal energy harvester**, **novel printable battery system** and wireless platform enabled by **3D heterogeneous integration** of these subsystems (see Fig. 1). The SmartVista sensors will reduce the risk of sudden deaths from cardiovascular disease, by enhancing detection and diagnosis performance. An electrocardiograph (ECG) is normally used to monitor abnormal heart rhythm, but sleep apnea could also lead to heart disease and stroke. Today's hospital-based monitoring systems are bulky and expensive, whereas wearable ECGs or respiratory monitors suffer from inaccuracies and short battery life. The SmartVista program will develop a flexible platform by integrating nanomaterials based sensors with ultra-high sensitivity to monitor ECG, respiratory flow, oxygen flow, the chemical analysis of human sweat composition and temperature powered by body heat energy conversion strategy through high efficiency thermoelectric generator to prolong the life of the printed battery. Additionally, the Roll-to-Roll manufacturing process of these patches will be developed to demonstrate the future scalability of this technology.

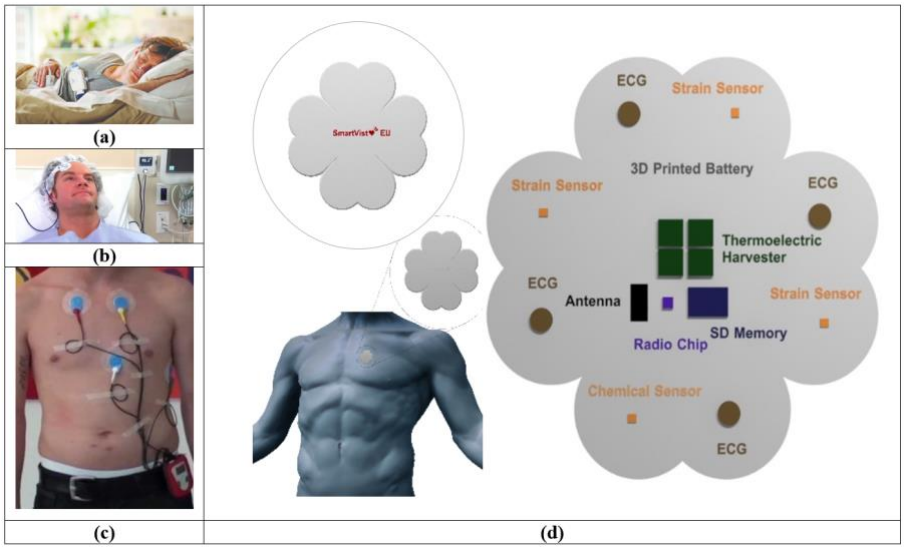

Figure 1. Market leading sleep apnea monitor, (a) Alice NightOne, Philips, (b) Temperature skin sensor from 3M, (c) State-of-art holter ECG monitor, MT-101, Schiller, (d) SmartVista platform replacing all above sensors (a-c). 3D illustration of SmartVista system for multi-modal sensing of vital signs for continuous health monitoring showing sensors, micro-thermoelectric generators, printable thin film battery, analog circuit and wireless transmitter.

Conclusion

SmartVista will develop the *first* nano/micro sensor-based vital sign monitoring system through comprehensive design, 3D integration, and packaging as a cost-effective and widespread application of wireless autonomous multimodal sensor system to reduce the sudden death due to cardiovascular disease.