

# Chapter 4

## Hybrid Integration Technology for Wearable Sensor Systems

**Li Xie**

*Thin Film Electronics ASA, Sweden*

**Lirong Zheng**

*Royal Institute of Technology, Sweden*

**Geng Yang**

*Zhejiang University, China*

### ABSTRACT

*Personalized and pervasive healthcare devices help seamlessly integrate healthcare and wellness into the daily life, independent of time and space. Silicon Integrated Circuit (IC) has been used in many advanced healthcare applications due to the compact size and ultra-low power consumption. Meanwhile, printed electronics (PE) is considered as a promising approach enabling cost-effective manufacturing of thin, flexible, and light-weight devices. A hybrid integration of IC and PE provides a new solution for the future wearable healthcare devices. In this chapter, firstly a customized bio-sensing IC is demonstrated, which can detect and process various bio-signals; secondly, the feasibility and performance of using inkjet printing technology as enabling technology has been examined for the fabrication of flexible bio-sensing devices. Finally, a wearable and flexible Bio-Patch is presented by leveraging hybrid integration of PE and bio-sensing IC. In-vivo test results show that the flexible Bio-Patch provides high quality ECG signal comparable with the one gained by bedside ECG machine.*

DOI: 10.4018/978-1-5225-1820-4.ch004

## INTRODUCTION

Consistent with the global aging, many countries are facing challenges of elderly care. In the meantime, chronic diseases are becoming the major causes of death (European Commission Eurostat, 2011; Kung, Hoyert, Xu & Murphy, 2008) the prevalence of chronic diseases inevitably increases the total expenditure on healthcare and poses a grim challenge to the current healthcare systems worldwide (Zhang, Yan, & Poon, 2007; Chen et al., 2015). Traditional healthcare and well-being services are usually provided within hospitals or medical centers. People with chronic diseases as well as the patients in post-surgery state need continuous monitoring of their health condition, in particular the vital signs, until their health status becomes stable. Patients, as well as their families, also need to collaborate with their physicians to get informed about their status. Until now, most of the monitoring of the health condition of such people is usually accomplished within medical centers or hospital environments. As a result, measurements of vital signs and the corresponding diagnosis are carried out in controlled environments. However, this solution is costly and inconvenient for people with the need of routine checks, since the patients need to visit the hospital on a regular basis. Currently, several trends indicate that the healthcare is gradually moving from institutional care to a growing focus on the individual personalized healthcare at home (Dey & Estrin, 2011; Saranummi, 2008; Yang et al., 2014).

Connected and personalized healthcare help seamlessly integrate healthcare and wellness into people's daily life. Wearable medical or healthcare devices are the key elements that will catalyze the process to enable the paradigm shift from the clinic-centric approach towards a person-centric model. This paradigm shifts focuses on sustainable healthcare aiming to:

- Enable early detection for prompt medical care and healthcare;
- Improve the management of chronic diseases; and,
- Preventive medicine.

The relevance of this change is huge, and healthcare itself, as it can be seen, is changing. The prognosis of several conditions will improve considerably because of prompt intervention; the users will be empowered and more engaged in the management of their disease or even in maintaining their health with a healthy and active lifestyle. Hopefully in many cases this will happen just by wearing certain sensing devices or clothes.

With the developments in biomedical circuits and systems, nowadays, silicon based integrated circuits have shown great advantages in terms of compact size and ultra-low power consumption. As a result, they have been found in many advanced

38 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: [www.igi-global.com/chapter/hybrid-integration-technology-for-wearable-sensor-systems/170238](http://www.igi-global.com/chapter/hybrid-integration-technology-for-wearable-sensor-systems/170238)

## Related Content

---

### Fuzzy-Decision Algorithms for Cyber Security Analysis of Advanced SCADA and Remote Monitoring Systems

Saša D. Mili (2020). *Cyber Security of Industrial Control Systems in the Future Internet Environment* (pp. 131-155).

[www.irma-international.org/chapter/fuzzy-decision-algorithms-for-cyber-security-analysis-of-advanced-scada-and-remote-monitoring-systems/250109](http://www.irma-international.org/chapter/fuzzy-decision-algorithms-for-cyber-security-analysis-of-advanced-scada-and-remote-monitoring-systems/250109)

### Industry 4.0 and the Internet of Things (IoT)

Zelal Gültekin Kutlu (2020). *Internet of Things (IoT) Applications for Enterprise Productivity* (pp. 1-24).

[www.irma-international.org/chapter/industry-40-and-the-internet-of-things-iot/250721](http://www.irma-international.org/chapter/industry-40-and-the-internet-of-things-iot/250721)

### A Trusted Ubiquitous Healthcare Monitoring System for Hospital Environment

Durga Prasad, Niranjan N. Chiplunkar and K. Prabhakar Nayak (2020). *Securing the Internet of Things: Concepts, Methodologies, Tools, and Applications* (pp. 239-252).

[www.irma-international.org/chapter/a-trusted-ubiquitous-healthcare-monitoring-system-for-hospital-environment/234947](http://www.irma-international.org/chapter/a-trusted-ubiquitous-healthcare-monitoring-system-for-hospital-environment/234947)

### A Neural Network-Based Automatic Crop Monitoring Robot for Agriculture

E. Udayakumar, S. Balamurugan and P. Vetrivelan (2019). *The IoT and the Next Revolutions Automating the World* (pp. 203-212).

[www.irma-international.org/chapter/a-neural-network-based-automatic-crop-monitoring-robot-for-agriculture/234031](http://www.irma-international.org/chapter/a-neural-network-based-automatic-crop-monitoring-robot-for-agriculture/234031)

### Performance Evaluation of a Three Node Client Relay System

Sergey Andreev, Olga Galinina and Alexey Vinel (2013). *Security, Design, and Architecture for Broadband and Wireless Network Technologies* (pp. 78-90).

[www.irma-international.org/chapter/performance-evaluation-three-node-client/77411](http://www.irma-international.org/chapter/performance-evaluation-three-node-client/77411)