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Bioelectronics and Medical Diagnostics

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The growing field of Bioelectronics deals with advanced electronics techniques to meet the needs of health care industry as well as other environmental and security applications. This interdisciplinary field integrates electronics and computer science with biology, medicine and applied sciences to solve problems related to design manufacturing and maintenance of medical devices and help to increase the span and quality of our lives.

Healthcare assisted technology and medical diagnostics are among the main challenges that could be addressed by Bioelectronics. There is still room to improve medical diagnostics and healthcare services by providing high-quality, innovative and cost-effective solutions that enable safe and effective patient care.

Wireless patient monitoring and diagnostics as well as intelligent medical imaging are among the high priority Bioelectronics research topics. A market analysis report indicates that the U.S. market for wireless healthcare monitoring systems has grown from $3.9 billion in 2007 to $8.9 billion in 2011 and is forecast to reach $20.9 billion by 2016 [1,2]. An embedded mobile ECG monitoring system was developed based on client–server architecture where the server (normally located in a hospital) stores ECG signals from the patient monitor (located in the patient's house) or a RFID reader [3]. This system communicates between medical device network and a mobile GPRS interface.

The development of 'Electronic Doctor's Bag' [4], with mobile communication link, is an example of remote medical diagnostics services. It measures patient's vital signs and performs ultrasonic diagnosis of the patient with compressed and coded video images. Some case studies have been set up with pilot trial of the system in integrating telehealthcare and decision support in the patient care management of chronic obstructive pulmonary disease and chronic heart failure [5] or automated diagnosis of heart arrhythmia [6].

We have developed a secure wireless telehealthcare monitoring system with its web-based application using off-the-shelves medical devices and software. The aim of this development is to make the system more affordable and easier-to-use. It performs vital signs monitoring and medical diagnostics of the patients and provides instance connectivity with physicians if required. A TV or any other screen monitors can be connected to enable two way video/audio tele-visiting and collect vital signs using wireless medical devices and send the information via internet [7]. Such information can also be stored in electronic patient records accessible by medical professionals in real time.

Recently, intelligent image and video processing have been becoming increasingly important in medical imaging, security and environmental monitoring. Innovative electronic systems with intelligent image processing algorithms can be employed for early diagnostics of medical conditions. A study has been conducted in our team to develope an efficient handheld spectral imaging system using the state-of-the-art embedded system technology for early diagnosis of skin cancer. Using system on chip (SoC) technolgy has made it possible to design the proposed novel vision system with the capability of running software on an ARM processor and accelerating it from hardware resources on a single chip. The research is ultimately aimed to address the need for a portable, non-invasive and accurate diagnosis embedded vision system [8].

These examples as well as many other reports show that Bioelectronics can improve medical diagnostics as a promising application of the future of healthcare [9]. Moreover, Bioelectronics as applied to health monitoring systems and medical diagnostics can play a significant role in reducing hospitalization, the burden on medical staff, consultation time, waiting time and overall healthcare costs.

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