

## Chapter 16

# Emerging Technologies and ICT Solutions in Healthcare

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### ABSTRACT

*The reaction of a human body under stress, on the onset of a disease or on being physically challenged is reflected by the fine changes in the human physiological parameters and hence is required to be repeatedly measured. The acquisition of data if done in real time enhances the sense of connectedness with the health care providers by sharing raw or interpreted physiological data. Emerging ICT tools in healthcare sector help in creating modular, software-defined test systems with improved throughput and flexibility for lesser overall costs. They also assist in designing advanced algorithms and developing prototype on off-the shelf hardware in a remarkable time frame. This chapter thus focuses on design and development of a system to acquire vital human physiological parameters like ECG, EMG and Carotid pulse waveform using latest technologically advanced ICT tools.*

### INTRODUCTION

The enhanced standard of living across the globe has resulted in better life expectancy in developing countries as well. The change is rapid and endlessly being challenged with the obligation of providing superior health care monitoring and attention either at health care centers or at remote locations. The reaction of a human body under stress, on the onset of a disease or on being physically challenged is reflected by the fine changes in the human physiological parameters and hence is required to be repeatedly measured. The applications could be varied and many requiring either need base or continuous measurement and analysis. The analysis may again be done at the point of measurement or away based on the situation or requirement. Quite clearly this opens a plethora of applications like monitoring patients at hospitals or remotely, to judge performance of sports men or women, evaluate the best of breed men posted at challenging high altitudes or while operating modern day equipment like jet planes and space ships or being cautious about the environment around the people involved in mining deep below the Earth's crust etc. Continuous monitoring of human physiology is of utmost importance in Biological

DOI: 10.4018/978-1-5225-0920-2.ch016

feedback systems as well, which provides the patients with on-line information on the functional status of their internal organs and systems.

The challenges faced are further multiplied by growing masses and incessant strain on state resources to provide quality health care. Accordingly, importance of development of simple, low cost, reliable, portable and expandable devices to detect, measure, transmit and automatically analyse the output enabling diagnostic and therapeutic decisions are the need of the hour. The implication and potential of these health monitoring technologies are paramount as they enable early detection of health deterioration and notify subtle changes in the physiological parameters. The acquisition of data if done in real time enhances the sense of connectedness with the health care providers by sharing raw or interpreted physiological data.

Thus, it is evident that safety, cost, quality and access are the major parameters on which the health care systems can be gauged objectively. However, reduced development time is also significant to ascertain an early position in an extremely competitive market. Emerging ICT tools in healthcare sector help in creating modular, software-defined test systems with improved throughput and flexibility for lesser overall costs. They also assist in designing advanced algorithms and developing prototype on off-the shelf hardware in a remarkable time frame. By tightly integrating hardware, software, validation, and reporting tools, vendors like National Instruments and Mathwork provide the best solution for rapidly developing and testing complex medical devices. Various systems used presently to detect, transmit and analyze human physiological parameters have addressed a wide variety of clinical and technical issues. Although enormous research efforts have been made in the fields of human physiological signal monitoring and signal feature extraction, most of them are truly not affordable and reachable to the masses. There is a further scope for improvement, especially in terms of noise sensitivity, universal connectivity, response time and on-line processing. Advancement in computer based portable data acquisition (DAQ) hardware and software could facilitate development of monitoring instruments which are not only simple but also provide compatibility at a much lesser cost. This chapter thus focuses on design and development of a system to acquire vital human physiological parameters like ECG, EMG and Carotid pulse waveform using latest technologically advanced ICT tools.

## **BACKGROUND**

Detection and analysis of carotid pulse waveform for its amplitude, periodicity and shape is done for the assessment of various physiological parameters, especially the cardiac functions of an individual (Karnath, & Thornton, 2002; Stanford Hospitals & Clinics, n.d). Schematic representation of carotid arteries is shown in Figure 1. The common carotid artery branches off from the aorta in pair and supplies oxygenated blood from the heart to the head and the brain through the neck. It gets further bifurcated in the neck into left and right external carotid arteries and left and right internal carotid arteries. External and internal carotid artery, one each is situated on either side of the neck. It is very easy to detect a pulse over the carotid artery on both sides of the neck. Physicians therefore often use the carotid artery to detect a pulse in patients who are in shock. Plaque deposition due to cholesterol, calcium, cellular wastes etc. on the inner walls of the carotid artery may narrow it down. This can lead to serious carotid artery diseases like Stenosis where reduced amount of oxygen rich blood reaches the brain. Severe blockage in the carotid artery may even lead to a stroke (Stanford Hospitals & Clinics, n.d). Blood flow measurements through these arteries are therefore an area of research where the pressure waveforms generated due to pulsation of carotid arteries needs to be critically analyzed.

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