Chapter 40
Energy Efficient Particle Optimized Compressed ECG Data over Zigbee Environment

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ABSTRACT

Standard Electrocardiogram Tracking instruments are huge to carry away over the remote areas for the surveillance. Holter is the compact instrument meant for collecting ECG of a patient without a pause while the patient is on the go of their daily activities. Holter works on battery for 48 hours without any angle of transmission but when allowed to transmit battery power dies soon, for these purposes some energy saving techniques is required. In this chapter the authors have proposed a Wavelet based Compression Technique, followed by Optimization under Genetic Algorithm and Particle Swarm Optimization. Compressed and Optimized ECG data has been transferred over Zigbee IEEE 802.15.4 with the intention of saving energy implicating it on a hardware chip. Transferred data will be available to the Doctor for on time treatment and further examination and storage. Embedded prior techniques in Holter can enhance its life, with fact of sending crucial data.

INTRODUCTION

Present time reveals the truth that there is a raise in the aging population, busy world and life taking diseases (Maneesha V. Ramesh et al., 2012). Ongoing era demands the early detection and prevention of death threatening diseases [2], out of a huge number here the main focus is on cardiovascular diseases

(S. Muthulakshmi and K. Latha, 2012). Cardiovascular diseases take a handsome share in the chart of death threatening diseases. People are too busy in their lives; this thing added a lot in pre death (UK. Jin Yoon et al., 2010). Scenario demands a system that will have a high check over the heart's abnormality, any oddness in daily life demands a Electrocardiogram (ECG) check up (Agus Dwi Swarjaya, 2012). This demands the idea of a technology that is fast, reliable and easy to communicate. In order to satisfy this desire we have to think for a new and efficient wireless technology called Wireless Sensor Network (Ali N. Akansu et al., 2010).Moreover, this has a revolutionary impact over the various research areas, out of a large number of areas our intention is on biomedical area which cover ups a large number of diseases that comes in human lifecycle (R. Gupta and M.mitra, 2012). Electrocardiogram is one of biomedical application which is closely related to WSN (Youssouf Zatout, 2012). Rhythm of heart is a electrical activity which is governed by the traditional ECG machine by placing various electrodes (which work as sensors) that senses the electric change and the same is passed onto the machine through wires which is reportedly drawn on a graph paper in the form of waves with each represented by P,QRS, T and U (S. Karpagachelvi et al., 2010). But our scenario has changed the traditional fact by miniaturizing the size of machine and making the sensing wire free and placing it on proximity of humans by keeping in mind sometime an instant check may not report the abnormalities, so some device need to monitor the patient continuously for a period of time (Benny P.L. Lo et al.). Holter is a monitoring device which actually works in the same way as the normal ECG machines work but on a go. Usually works for 24 or 48 hours after which the stored data will be used by the doctor to report the abnormalities (Shao. Yen Tseng et al., 2009). Where if Holter instead of storing large amount of data keep on sending its acquired data continuously, but this procedure will eat up all the battery cells and Holter machines dies soon before even lasting for 24 hours because during wireless communication most of the energy is wasted. Various authors have tried to overcome this drawback to certain extent they succeeded, out of a number of reach, some have tried to work with the compression method whose job is to cut down the irrelevant data as in the previous work Discrete Cosine transformation is used which creates discrete samples, compresses them and send them wirelessly (Tellez Camiilo et al., 2009). Lack to overcome the battery life of Holter machine as Bluetooth transmission is being used and only the frequency component of ECG is taken into consideration. Our work has overpowered the drawbacks by implementing discrete wavelet transformation (DWT) as a compression method, which discretely compresses the various frequency and time samples over discrete times before compression pre-filtration is done with the help of various filters depending upon the noise ECG data contains (Li Xuemei et al., 2008). Compression only removes the unwanted or less important data from the main data but this is not enough to save energy, this puts up with the idea of optimization (Emran Mohammad Abu Anas et al.,2010).Optimization means how well the compressed data can be further enhanced without changing the meaning of the overall data (Sateh M.S. Jalaleddine et al., 1990). Optimization works on the mirror image samples, whose removal will not lead the data in unwanted state or non-meaningful (Jos Hulzink et al.,2011). Great optimization techniques have been proposed out of large category some of them are listed below-Genetic algorithm, Particle swarm optimization, Ant colony optimization etc (Rozeha A. Roshid et al., 2008).

Genetic algorithm basically gives a simple solution termed as chromosome, where its collection called as population (Hossein Mamaghanian et al., 2011). Each chromosome undergoes a process of fitness evaluation in order to check the suitability of the candidate solution for the problem. Some chromosomes undergo the process of crossover as chromosomes exchange their values or genes, where some undergo mutation where an old value is replaced by new value. Chromosomes that undergo crossover process

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