Fitness Function Based ECG Data Compression Optimization with Genetic Algorithm – A Review

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Abstract—Trend of wearable ECG sensors is in its rising mode. ECG sensors run on batteries, hence carry a limited battery life. Body wearable sensors are used to continuously monitor the patients for their routine organ performance. They use some kind of internet connectivity to connect to the central patient database server. Body wearable sensors forward the patient data to the central database using some kind of internet facility like cellular networks, Wi-Fi, Zigbee or other mediums. If the signal to be transported will be optimized or compressed then it would be easy to transfer the signal to the central server over the internet connections. In this research, we are trying to solve this problem. Wireless sensors, usually, get connected with WiFi or WiMAX. They can also be connect on mobile networks or personal networks (GSM, CDMA, Bluetooth, Irda, etc). Hence, the ECG data can be sent to the central medical database servers via any of the above mentioned methods. Wearable sensors are used as ECG data processing and sending units. But to run ECG data transfers on body wearable sensors, it consumes a handful amount of bandwidth, so the ECG signal can be doctored or corrupted on the communication path. In this paper, ECG signal will be compressed and optimized (optimized, noun optimization: can be termed as refined and compressed) using any effective signal optimization method. This will reduce the load on data transfer link. Hence, it will improve the performance of the wearable ECG signals. The ECG signal optimization would be done using Fitness function based Genetic Algorithm because Fitness function based genetic algorithms is an effective and robust optimization technique. Using this technique, the variety of ECG signal can be optimized using the quantization scheme of fitness function based ECG data compression based on a genetic algorithm. The compression performance and convergence speed of reconstruction quality maintenance will be evaluated by using the MIT-BIH arrhythmia database.

Keywords—ECG(Electrocardiography), PSO(Particle Swarm Optimization) Genetic Algorithm (GA), FECG (Fetus electrocardiogram)

I. INTRODUCTION

Electrocardiography is used to measure the electrical activity related to heart. The empirical of ECG signal to enhance the measurement perfection. The ECG signal is recorded to identify the change in heartbeat. It picks up electrical impulses generated by the polarization and depolarization of cardiac tissue and translates into waveform. Most ECGs are performed for diagnostic or research purposes on human hearts, but may also be performed on animals, usually for diagnosis of heart abnormalities or research. The heartbeat of FETUS is senses by the Fetal ECG sensor during pregnancy period. To maintain the health of fetus and mother the Fetal Heart Beat Rate monitoring is very much important. Mostly 2G Fetal ECG sensor are more effective for remote areas and slums areas. The most important thing about 2G network is 2G network caries less transmission speed on internet. In 2G network the signal which are optimized or compressed are easily propagate over 2G with less ECG data loss. Using Particle Swarm Optimization (PSO) and Genetic Algorithm (GA) these ECG signal are optimized. If we optimized the signal than these optimized signal can also improve the quality of the ECG signal.

Data acquisition is the first step in ECG signal analysis. Mostly in Data acquisition the data is collected from real subjects but in this thesis the Data is collected from online database. Signal pre-processing is the next step in this step obtained ECG signal is filtered so that its noise removed and to apply compression or optimization. QRS detection is the third step. To find the smallest set of features which maximize the classification performance is the fourth step and the last step is the categorize the signal into three different cardiac condition. ECG of fetal is observed with ordinary fetal ECG biomedical device or body wearable sensors. During pregnancy there is always the need of monitoring the fetal ECG. When ECG signal is received from these body wearable sensors for fetal ECG than it sent to the medical databases by using different type of mediums. The obtained data can be sent over GSM, Wi-Fi, and CDMAetc. If we compressed or optimized the Fetus ECG signal than it can be effectively transferred to the medical databases and it also take less transmission time. Compressed Fetus ECG signal are performed by various algorithms but sometimes it gives false data when we decompressed these signal at other end, on the other hand optimization is much more effective than...
compression. Optimization of fetus ECG signal is the technique in which we optimized the signal to the best values possible and it also lower the signal size.

ECG of fetal is a process of measuring variation in the fetal cardiac cycle. Due to this process we get more help in fetal surgery. We can use two type of system direct and indirect. In first type scalp electrodes are commonly used and in second type maternal abdominal wall sense the ECG. At the time of labour only direct recording is performed because in abdominal ECG more difficulties are mainly faced. Fetal Signal magnitude is in several micro volts as compared with 1 to 2mV of maternal ECG. In medical application ECG is one of the oldest and best instrument bound measurements. It has followed the advancement of instrumentation technology. Its most recent progression step is the computer based system which allow patient to wear their computer monitor to upgrade the high resolution ECG that open new scene of ECG analysis and interpretations.

II. LITERATURE REVIEW

Zhilin Zhang, Tzuy-Ping Jung, Scott Makeig, Bhaskar D. Rao have developed a new technique for compressed sensing for Energy-Efficient Wireless Tele-monitoring of Non-Invasive Fetal ECG via Block Sparse Bayesian Learning[1]. They have proposed the use of block sparse Bayesian learning (BSBL) framework for compression/reconstruction of non-sparse raw FECG recordings. Maryam Nasiri et. al. have proposed a new method for extraction of Fetal Electrocardiogram Signal based on adaptive Nero-Fuzzy Inference System[2]. In this paper, the authors have proposed a new method of FECG signal extraction from two ECG signals recorded at thoracic and abdominal areas of mother. S. Sargolzaei, K. Faez, A. Sargolzaei have developed a new technique named Signal Processing Based Techniques for Fetal Electrocardiogram Extraction[3]. In this paper, authors have described four important indirect methods which be used to extract the fetal Electrocardiogram (FECG) signal from an ECG recorded on the mother’s abdomen. These methods include the following ones: singular value decomposition (SVD) method, independent component analysis (ICA) method, wavelet based methods and adaptive filtering method. Assaleh, K. have proposed the method of extraction of fetal electrocardiogram using adaptive neuro-fuzzy inference systems[4]. The authors have investigated the use of adaptive neuro-fuzzy inference systems (ANFIS) for fetal electrocardiogram (FECG) extraction from two ECG signals in this paper. Camps, G., Martinez, M., & Soria, E. have developed a technique of Fetal Ecg extraction using an FIR neural network[5]. Camps, G. et. al. have proposed Fetal ECG signal recovery using dynamic neural networks[6]. Mehmet Korurek et. al. have proposed a classification method using PSO for ECG signal[7]. Tsung-Ching Wu, King-Chu Hung, Je-Hung Liu, Tung-Kuan Liu have collectively developed a new technique based on wavelet-based ECG data compression optimization with genetic algorithm.

III. PROBLEM FORMULATION

Trend of wearable Fetal ECG sensors is in its rising mode. FECG sensors run on batteries, hence carry a limited battery life. Body wearable sensors are used to continuously monitor the patients for their routine organ performance. They use some kind of internet connectivity to connect to the central patient database server. Body wearable sensors forward the patient data to the central database using some kind of internet facility like cellular networks, Wi-Fi, Zigbee or other mediums. If the signal to be transported will be optimized or compressed then it would be easy to transfer the signal to the central server over the internet connections. In this research, we are trying to solve this problem. Wireless sensors, usually, get connected with WiFi or WiMAX. They can also be connect on mobile networks or personal networks (GSM, CDMA, Bluetooth, Irda, etc). Hence, the Fetal ECG data can be sent to the central medical database servers via any of the above mentioned methods. Wearable sensors are used as FECG data processing and sending units. But to run FECG data transfers on body wearable sensors, it consumes a handful amount of bandwidth, so the FECG signal can be doctor or corrupted on the communication path. In this paper, FECG signal will be compressed and optimized (optimized, noun optimization: can be termed as refined and compressed) using any effective signal optimization method. This will reduce the load on data transfer link. Hence, it will improve the performance of the wearable FECG signals. The FECG signal optimization would be done using Fitness function based Genetic Algorithm because Fitness function based genetic algorithms is an effective and robust optimization technique. Using this technique, the variety of FECG signal can be optimized using the quantization scheme of fitness function based FECG data compression based on a genetic algorithm. The compression performance and convergence speed of reconstruction quality maintenance will be evaluated by using a novel fetal FECG database.

IV. PROPOSED MODEL

Wireless sensors, usually, get connected with WiFi or WiMAX. They can also be connect on mobile networks or personal networks (GSM, CDMA, Bluetooth, Irda, etc). Hence, the FECG data can be sent to the central medical database servers via any of the above mentioned methods.
Wearable sensors are used as ECG data processing and sending units. But to run FECG data transfers on body wearable sensors, it consumes a handful amount of bandwidth, so the FECG signal can be doctored or corrupted on the communication path. In this paper, FECG signal will be compressed and optimized (optimized, noun optimization: can be termed as refined and compressed) using any effective signal optimization method. This will reduce the load on data transfer link. Hence, it will improve the performance of the wearable FECG signals. The FECG signal optimization would be done using Fitness function based Genetic Algorithm because Fitness function based genetic algorithms is an effective and robust optimization technique. Using this technique, the variety of FECG signal can be optimized using the quantization scheme of fitness function based FECG data compression based on a genetic algorithm. The compression performance and convergence speed of reconstruction quality maintenance will be evaluated by using a novel fetal ECG database.

V. CONCLUSION AND METHODOLOGY

At first, the literature on the Body wearable sensors in body area networks for FECG signal processing would be studied in detail. Then the algorithm flow would be reviewed and refined in case any changes are required. Afterwards, the algorithm would be programmed in MATLAB. The experiment results would be thoroughly analyzed and compared with the existing algorithm results.

REFERENCES


