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Extracting Fetal ECG from a Single Maternal Abdominal Record

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Abstract- This work presents the variations of photoplethysmogram (ECG) morphology with age. ECG measurement is done noninvasively at the index finger on both right and left hands for a sample of erectile dysfunction (ED) subjects. Some parameters are derived from the analysis of ECG contour showed in association with age. The age is found to be an important factor that affects the contour of ECG signals which accelerates the disappearance of ECG's dicrotic notch and ECG's inflection point as well. Arterial compliance is found to be degraded with age due to the fall of arterial elasticity. This study approaches the establishment of usefulness of ECG's contour analysis as an investigator to the changes in the elastic properties of the vascular system, and as a detector of early sub-clinical atherosclerosis.

Keywords: *Big data, NoSQL, Polarity Classification, Parallel Processing, Recommender System.*

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I. INTRODUCTION

Signal processing is an area of systems engineering, electrical engineering and applied mathematics that deals with operations on or analysis of analog as well as digitized signals, representing time-varying or spatially varying physical quantities. Signals of interest can consists sound, electromagnetic radiation, images, and sensor readings, for example biological measurements such as electrocardiograms, control system signals, telecommunication transmission signals, and many others [1].

The goals of signal processing can roughly be divided into the following categories.

- Signal acquisition and reconstruction, which involves measuring a physical signal, storing it, and possibly later rebuilding the original signal or an approximation thereof. For digital systems, this typically includes sampling and quantization.
- Quality improvement, such as noise reduction, image enhancement, and echo cancellation.
- Signal compression (Source coding), including audio compression, image compression, and video compression.

Feature extraction, such as image understanding and speech recognition.

Analog signal processing is for signals that have not been digitized, as in legacy radio, telephone, radar, and television systems. This involves linear electronic circuits as well as non-linear ones. The former are, for instance, passive filters active filters, additive mixers, integrators and delay lines [2]. Non-linear circuits include compandors, multiplications (frequency mixers and voltage-controlled amplifiers), voltage-controlled filters, voltage-controlled oscillators and phase-locked loops.

Digital signal processing is the processing of digitalized discrete-time sampled signals. Processing is done by general-purpose computers or by digital circuits such as ASICs, field-programmable gate arrays or specialized digital signal processors. Typical arithmetical operations include fixed-point and floating-point, real-valued and complex-valued, multiplication and addition. Other typical operations supported by the hardware are circular buffers and look-up tables. Examples of algorithms are the Fast Fourier transforms (FFT), finite impulse response (FIR) filter, Infinite impulse response (IIR) filter, and adaptive filters such as the Wiener and Kalman filters [3].

II. BACKGROUND

The main process of Hong algorithm include normalization, local orientation estimation, local frequency estimation, and filtering. A bank of Gabor filters, which is tuned to local ridge orientation and ridge frequency, is applied to the ridge and valley pixels in the normalized input Voice image to obtain an enhanced Voice image. The filters are used as bandpass filters to remove the noise and preserve true ridge/valley structures. We implemented this algorithm for comparison purposes introducing some modification. First, an alternative scheme, based on local gradient operations, is used for more precise orientation estimation. Fine tuning of some parameters in the original algorithm result in an efficient and more robust algorithm [4].

The signal captured by the sensor from a biometric identifier depends upon both the intrinsic biometric identifier characteristic as well as the way the biometric identifier was presented. Thus, an acquired biometric signal is a nondeterministic composition of a physical biometric trait, the user characteristic behavior, and the user interaction facilitated by the acquisition interface. For example, the three-dimensional (3-D) shape of the finger gets mapped onto the two-dimensional (2-D) surface of the sensor surface [5]. As the finger is not a rigid object and since the process of projecting the finger surface onto the sensor surface is not precisely controlled, different impressions of a finger are related to each other by various transformations. Further, each impression of a finger may possibly depict a different portion of its surface. In case of face acquisition, different acquisitions may represent

different poses of the face. Hand geometry measurements may be based on different projections of hand on a planar surface. Different iris/retina acquisitions may correspond to different no frontal projections of iris/retina on to the image planes. Face recognition presents a challenging problem in the field of image analysis and computer vision, and as such has received a great deal of attention over the last few years because of its many applications in various domains. In [6] Face recognition techniques can be broadly divided into three categories based on the face data acquisition methodology: methods that operate on intensity images; those that deal with video sequences; and those that require other sensory data such as 3Dinformation or infra-red imagery. In this paper, an overview of some of the well-known methods in each of these categories is provided and some of the benefits and drawbacks of the schemes mentioned therein are examined. Furthermore, a discussion outlining the incentive for using face recognition, the applications of this technology, and some of the difficulties plaguing current systems with regard to this task has also been provided. This paper also mentions some of the most recent algorithms developed for this purpose and attempts to give an idea of the state of the art of face recognition technology.

III. PROPOSED METHOD

A. *DataFlow*

In the data flow is to describe the In RGB Images there exist three indexed images. First image contains all the red portion of the image, second green and third contains the blue portion. So for a 640 x 480 sized image the matrix will be 640 x 480 x 3. An alternate method of colored image representation is Indexed Image. It actually exist of two matrices namely image matrix and map matrix. Each color in the image is given an index number and in image matrix each color is represented as an index number. Map matrix contains the database of which index number belongs to which color [7].

B. *Systolic Pea and Ddiastolic Peak*

Systole is the part of the cardiac cycle when the ventricles contract. It systolic peak measures the amount of pressure that blood exerts on arteries and vessels while the heart is beating. The mammalian heart has 4 chambers: the left atrium, the left ventricle, the right atrium and the right ventricle. When the smaller, upper atria chambers contract in late diastole, they send blood down to the larger, lower ventricle chambers. When the lower chambers are filled and the valves to the atria are closed, the ventricles undergo is volumetric contraction (contraction of the ventricles while all valves are closed), marking the first stage of systole [8]. The second phase of systole sends blood from the left ventricle to the aorta and body extremities and from the right ventricle to the lungs. Thus, the atria and ventricles contract in alternating sequence. The left and right atria feed blood, at the same time, into the ventricles. Then, the left and right ventricles contract simultaneously as well. Cardiac systole is the contraction of the cardiac muscle in response to an electrochemical stimulus to the heart's cells (cardiomyocytes). The cardiac output (CO) is the volume of blood pumped by the left ventricle in one minute. The ejection fraction (EF) is the volume of blood pumped divided by the total volume of blood in the left ventricle [9].

Diastole is the part of the cardiac cycle when the heart refills with blood following systole (contraction). Ventricular diastole is the period during which the ventricles are filling and relaxing, while a trial diastole is the period during which the atria are relaxing. Diastole means dilation and it is closely related to the phenomenon of recoil within ballistics. The diastolic pressure is specifically the minimum arterial pressure during relaxation and dilatation of the ventricles of the heart when the ventricles fill with blood. In a blood pressure reading, the diastolic pressure is typically the second number recorded. For example, with a blood pressure of 120/80 ("120 over 80"), the diastolic pressure is 80. By "80" is meant 80 mm Hg (millimeters of mercury). A diastolic murmur is a heart murmur heard during diastole, the time the heart relaxes. "Diastolic" came from the Greek diastole meaning "a drawing apart." The term has been in use since the 16th century to denote the period of relaxation of the heart muscle [10]. During ventricular diastole, the pressure in the (left and right) ventricles drops from the peak that it reaches in systole.

C. *Stiffness Index*

Arterial stiffness occurs as a consequence of biological aging and arteriosclerosis. Increased arterial stiffness is associated with an increased risk of cardiovascular events such as myocardial infarction and stroke, the two leading causes of death Cardiovascular disease will also be the leading killer in the developing world and represents a major global health problem. Several degenerative changes that occur with age in the walls of large elastic arteries are thought to contribute to increased stiffening over time, including the mechanical fraying of lamellar elastic structures within the wall due to repeated cycles of mechanical stress; changes in the kind and increases in content of arterial collagen proteins, partially as a compensatory mechanism against the loss of arterial elastin and partially due to fibrosis. An increase in arterial stiffness also increases the load on the heart, since it has to perform more work to maintain the stroke volume [11].

D. *Augmentation Index*

The augmentation index is a ratio calculated from the blood pressure waveform, it is a measure of wave reflection and arterial stiffness. Augmentation index is commonly accepted as a measure of the enhancement (augmentation) of central aortic pressure by a reflected pulse wave [12].

E. *Relaxation Index*

Strain relaxation index (SRI) is introduced to assess diastolic function by CMR, using myocardial deformation during LV relaxation. We investigate how SRI relates to standard diastolic parameters by echocardiography (echo). We also relate SRI to mass to volume ratio (MVR) by CMR, which is seen to increase in diastolic dysfunction. SRI accounts for both very early myocardial relaxation and tissue compliance.SRI was calculated as the difference between post-systolic and systolic times of the strain peaks

(indicator of myocardial relaxation), divided by the early diastolic strain rate peak (measure of tissue compliance) [14]. It was normalized by the total relaxation time, calculated as the difference between the RR interval and the systolic interval. CMR LV mass and end-diastolic volumes were assessed by the Simpson method. Tissue Doppler echo assessed lateral and septal diastolic tissue velocity echo pulse-wave Doppler E peak was divided by the average of septal and late waves [15].

IV. RESULT AND DISCUSSION

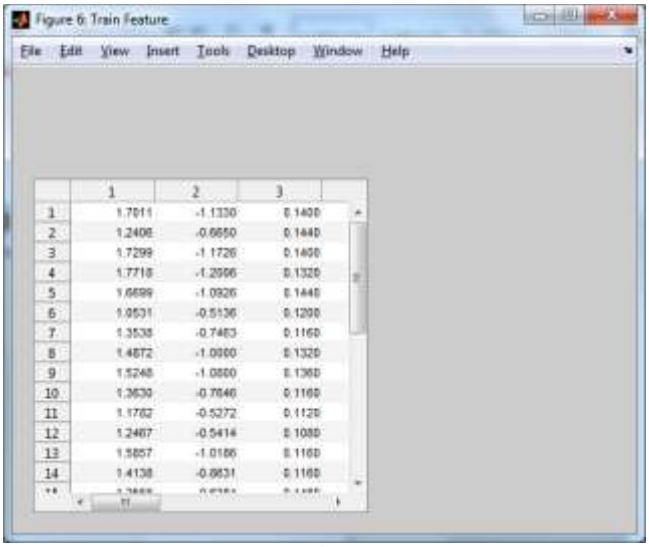

Fig. 1: Result of training dataset

In this proposed work, its first work contribution extracts an estimate of the maternal ECG by processing the abdominal signal through a smoothing Butterworth filter. The estimated maternal ECG is then nonlinearly aligned with the abdominal signal using polynomial networks to extract the fetal ECG signal results on synthetic. The real abdominal ECG data show that the proposed method can extract fetal ECG with signal quality comparable or better than that extracted by multichannel based methods. This method is used to medical earlier diagnosed system of CVD.

This work totally relies on data collected from the clinics. The results obtained are simulated in Mat lab environment. Future the work is to be extended by evaluating and determining the research in real time environment.

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