ECG NOISE REDUCTION TECHNIQUE USING ANTLION (ALO) ALGORITHM FOR HEART RATE MONITORING DEVICES

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Engineering (Electronics)

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at University Malaysia Pahang or any other institutions.

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ABSTRAK

Terdapat lebih daripada 6 bilion orang yang masih hidup hari ini, dan jumlahnya dijangka mencapai 9 bilion dalam 30-40 tahun akan datang. Oleh kerana penurunan kadar kelahiran dan peningkatan orang usia disyaki bahawa jumlah orang tua akan lebih banyak daripada anak kecil pada masa yang akan datang. Teknologi yang boleh dipakai dapat memberikan penyelesaian untuk menyediakan perawatan kesihatan bagi pertumbuhan populasi yang semakin tua. Berdasarkan laporan Pertubuhan Kesihatan Sedunia (2016), Penyakit Kardiovaskular (CVD) adalah penyebab kematian utama di dunia. Teknologi yang dapat dipakai untuk meringankan beban ruang perawatan peribadi dan hospital dapat menyediakan tempat untuk orang lain. Oleh kerana bunyi isyarat ECG berada dalam frekuensi rendah, ia mudah diganggu oleh bunyi yang lain; terutamanya bunyi dari elektrik dan intensiti fisiologi. Ini akan menyebabkan masalah gangguan morfologi dan akan doktor sukar mengenal pasti apa penyakitnya Akibatnya, ini sangat penting untuk mengenali morfologi ECG. Ini keranamorfologi ECG memberi banyaksokongan dalam menganalisis maklumat mengenai gangguan jantung. Tesis ini bertujuan untuk meneliti cara yang berkesan untuk menetapkan parameter fisiologi kritikal manusia - degupan jantung. Salah satu objektif penyelidikan adalah untuk mengenal pasti morfologi isyarat elektrokardiogram dengan menggunakan penapis median untuk mengurangkan kebisingan frekuensi tinggi untuk pangkalan data ECG. Objektif kedua adalah mengenal pasti dan mengoptimumkan frekuensi cutoff menggunakan Antlion optimization (ALO) untuk filter FIR. Teknik pemprosesan isyarat - Antlion Optimizer (ALO) dapat membantu mencari frekuensi pemotongan. Dengan mengetahui frekuensi pemotongan, ia akan membantu dalam mengurangkan kebisingan isyarat ECG. Frekuensi pemotongan digunakan pada penapis Impite Terhingga (FIR) untuk mendapatkan isyarat ECG yang asli dan bersih. Dari simulasi, frekuensi pemotongan yang dioptimumkan diambil lebih tinggi daripada nisbah isyarat kepada kaedah konvensional (SNR). Prestasi frekuensi cutoff kaedah yang dicadangkan adalah dengan frekuensi cutoff konvensional ciri pengekstrakan. Hasil frekuensi pemotongan optimum ALO menunjukkan bahawa kaedah yang dicadangkan mengurangkan lebih banyak bunyi daripada kaedah konvensional.

ABSTRACT

There are more 6 billion people alive today, and the number is expected to reach until 9 billion in coming 30-40 years. As of the declining of the birth rate and booming aging population, it is suspected that number of elderly people will be more than young children in human history. Wearable technology may provide the solution for providing health care to the growth of the aging population. Based on World Health Organization (2016) report, it has been found out that Cardiovascular Diseases (CVD) is the world's leading cause of death. Wearable technology solutions could ease the burden on health-care personal and hospital space more emergent or responsive care at the same time. Since the electrocardiogram (ECG) noise is in the low frequency, it is very easy interrupt with the noise; especially noise from electrical and the intensity of physiological. It will lead to the problem on interruption the morphology and it will make doctors hard to identify what is the disease are. As a result, this is very important to obtain the clean and clear on the morphology of ECG. This is because the morphology of ECG supports in analyzing many information of the heart disorder. This thesis aims to research into an effective way to capture human critical physiological parameters - heart rate. One of the objectives of the research is to identify the morphology of electrocardiogram signal by using the median filter to reduce the high frequency noise for the ECG database. Second objective is to identify and optimize the cutoff frequency using the Antlion optimization (ALO) for FIR filter. The signal processing techniques - Antlion Optimizer (ALO) can help on finding the cutoff frequency automatically. By finding out the cutoff frequency, it will bring to the cancelling noise stage. The cutoff frequency is applied to a Finite Impulse filter (FIR) for getting an original and clean ECG signal. From the simulations, the optimized cutoff frequency is retrieved in higher than the conventional method's signal to ratio (SNR). The proposed method's cutoff frequency performance was with the conventional cutoff frequency of feature extraction of the signal. The ALO optimum cutoff frequencies' result shows that the proposed method reduced more noise than the conventional method.

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LIST OF SYMBOLS

ECG	Electrocardiogram
FIR	Finite impulse response
FFT	Fast Fourier Transform

LIST OF ABBREVIATIONS

ALO	Antlion Optimization
ECG	Electrocardiogram
FIR	Finite impulse response
FFT	Fast Fourier Transform
SNR	Signal Noise Ratio
Fc	Cutoff Frequency
Fs	Sampling Frequency
PPG	Photoplethysmography
GA	Genetic Algorithm
ABC	Artificial Bee Colony
PSO	Particle Swarm Optimization
DFT	Discrete Fourier Transform

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