May – June 2020
ISSN: 0193-4120 Page No. 333 - 337

Reducing End to End Delay through Enhanced Hybrid LDAPSO Algorithm for ECG Signal in WBAN

[1]E. Ramya, [2]Dr. R. Gobinath
[1]Assistant Professor, Department of Computer Science,SDNB Vaishnav College,Chrompet,Chennai.E-mail: ramyaprabakaran@gmail.com
[2]Associate Professor, Department of Computer Science, VISTAS, Chennai.
E-mail: iamgobinathmca@gmail.com

Article Info
Volume 83
Page Number: 333 - 337
Publication Issue:
May - June 2020

Article History
Article Received*: 11August 2019*
Revised*: 18November 2019*
Accepted*: 23January 2020*
Publication*:07May2020*

Abstract:
Emerging technologies of wireless body area network (WBAN) has brought a new and huge hope for solving the problems of aging of populations, different chronic diseases, and shortage of medical facility. Designing of routing algorithms becomes an essential part of WBANs and it plays an important role in calculating the performance and quality of service in sensor network. In this paper an Enhanced particle swam optimization (PSO) algorithm is used for reducing end to end delay by finding relevant path in wireless body area network. The research work carried out in this paper is to reduce the end to end delay by calculating and applying the fitness value and best particle with relevant optimal path using optimized PSO algorithm. Furthermore with the relevant path the optimal node transmitted the extracted ECG data packets in healthcare centers.

Keywords:*Wireless Body Area Sensor Network, End to end delay, Particle swarm optimized algorithm, ECG data.*

I. INTRODUCTION

In the fast development of the wireless sensor technology and wireless communication technology. WBAN technology plays a main part.

The below figure describes the three tier architecture of WBAN. WBAN network is a 3-tier architecture. In the one tier architecture the collection of the sensors are implanted in the surface of the body and its function is to gather the physiological data about the human body.

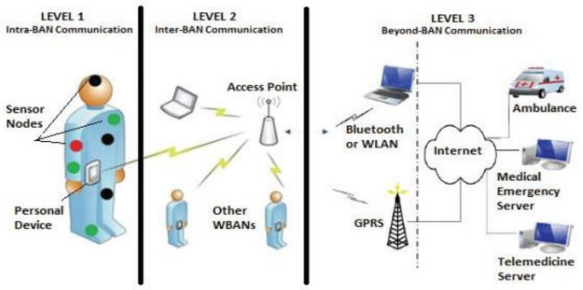

Figure1. WBAN Architecture

In the two tier architecture it is composed of PCs, smart phones and intelligent electronic devices. The wireless modes forwards the information from the sensors to the terminal data center. In the three tier architecture it is composed of remote servers with various applications and its main function is analyzing the information which is received from the sensors. When the sensor nodes sends the abnormal

May – June 2020
ISSN: 0193-4120 Page No. 333 - 337

data it was analyzed, and the abnormalities are rectified.

II. Literature Review

- Yun-Chi Yeh, Wen-june Wang, chewun chiou et al. implemented the Linear Discriminant analysis method to analyse and diagnose the cardiac arrhythmias in ECG signals. The normal and abnormal heartbeat of ECG signal are classified and differentiated accurately [4].
- Muhammed fahad shinwari, Naveed Ahmed, Hassan Humayun et al. developed a framework with a combination of framework with a combination of Linear Discriminant Analysis and Cross-correlation. They used different types of ECG signals with different states for the simulation they have created [5].
- Vimalarani, R.Subramanian, N.Sivanandam et al. developed an enhanced PSO based clustering energy optimization algorithm. They minimized the power consumption in wireless selection with the implementation of optimized algorithm [10].
- Meetali Thakur, Er Parvinder Singh et al. designed a simulator for health monitoring system using optimization algorithm. The simulation is being carried out in MATLAB tool with the parameters of end to end delay, throughput, energy consumption and finally with the error rate calculation [11].

III. Exisiting Methodology

3.1 Feature Extraction Methods

3.1.1 Cross – Correlation

Cross Correlation is a statistical tool that is used to match the signals with each other. It is used to match the signals with each other. It is used to reduce the noise. It is used to measure the same type of waveforms as a function of time-lag that is applied to one among them.

The mathematical form for the discrete functions f and g is declared and defined as

$$(f * g)[y] = \sum_{x=-\infty}^{\infty} f * [x] g[y + x] \quad (1)$$

Cross-Correlation is used as a pattern recognition technique. The raw ECG signal was cross – correlated with each and every signals. It is also determined with its proper coefficient values. Finally the threshold values are predicted for each and every signals with the exact functions. After correlating the unknown signals, the coefficient values are generated for each signal.

3.1.2 Linear Discriminant Analysis

Linear Discriminant Analysis is a technique that is used for feature extraction. This technique is used to identify the transformation from the higher to a lower dimensional space. This transformation gives the clear and exact information about the features that are extracted from the ECG signal.

The mathematical form for the LDA is described as

$$Di\,(x)\; Ln\,(p\,(ci)) + xt\; c - 1\; mi + \tfrac{1}{2}\; mi\; T\; c - 1\; mi \quad (2)$$

3.1.3 Particle Swam Optimization

The particles are first initialized as randomly. Each and every particle's fitness are measured. The velocity of each particles are calculated and updated until it reaches the criteria. To reach the optimal solution, each particles updates its velocity according to the components and the perception.

$$Vtid = wVt - 1id + c1\; rand1\; (ptid - x^{t}_{id+}\; c_2\; rand_1\; (p^{t}_{id} - x^{t}_{id})\; d=1,2\ldots\ldots,D \quad (3)$$

To reach the optimal solution, each particles updates its velocity according to the components and the perception.

IV. PROPOSED METHODOLOGY

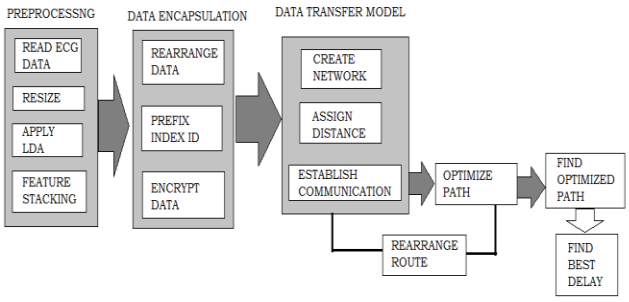

Figure 2. Flow diagram of Reducing End to End delay using Enhanced Hybrid LDAPSO Algorithm

May – June 2020
ISSN: 0193-4120 Page No. 333 - 337

V. Algorithm Flow

STEP 1: PREPROCESSING

The preprocessing steps involves reading the ECG data, resizing the data to the NxM matrix and Nx1 Vector to fetch into the LDA feature extraction

STEP 2: LDA feature extraction

Once the input data have been resized, fetch the NxM data and vectorized ECG input Nx1 data into the LDA function

STEP 3: LDA algorithm evaluation

- The d−dimensional to dimensional mean vectors are calculated for the different classes from the dataset.
- The scatter matrices are calculated in between the class and also within the class scatter matrix.
- The eigenvectors and corresponding eigenvalues are calculated for the scatter matrices.
- The eigenvectors are sorted by reducing the eigenvalues to form an exact dimensional matrix d*kd*k.
- The exact eigenvector matrix is used to transform the sample signals on to the new subspace and finally can be summarized by the matrix multiplication.

STEP 4: Evaluate PSO Algorithm – Generate Random Network Nodes

Particle swarm optimization (PSO) algorithm is an optimization technique developed by Dr. Eberhart and Dr. Kennedy in 1995, based on social behaviour of bird flocking or fish schooling. The PSO algorithm is mainly used to search a patterns in the large region in the solution space of the optimized objective function [12].

STEP 5: Steps involved in PSO algorithm

- Get the feature extracted values
- Generate random Nodes
- Initialize position to all Nodes
- Calculate weights of each nodes
- Compare the weights of nodes and positions to find the best possible route with less distance
- Update the route
- Update the weights & Positions if any
- Repeat until Best route found with best delay
- End the optimization

Here optimization we mean is adjustment of node positions & weights.

I. RESULTS AND DISCUSSIONS

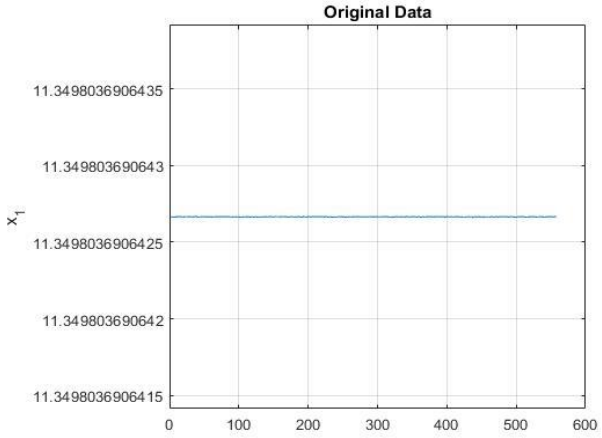

Figure 3. Visualization of original input samples under Test

The above figure shows the visualization plot of original ECG data collected for test. The samples are resized to fixed dimension and plotted here. The original raw data contains the noise data present in it which is further removed by Linear Discriminant Analysis.

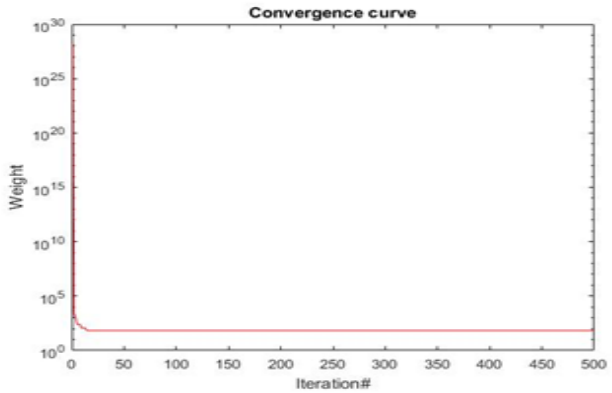

Figure 4. Convergence plot of feature Extracted samples

May – June 2020
ISSN: 0193-4120 Page No. 333 - 337

The above figure depicts the convergence plot which is used to analyze the statistical parameters of the feature extracted data such as mean, minimum, maximum etc. The factors are maintained in the constant range which shows the convergence of algorithm. The convergence is measured with respect to number of iterations vs weightage of the algorithm.

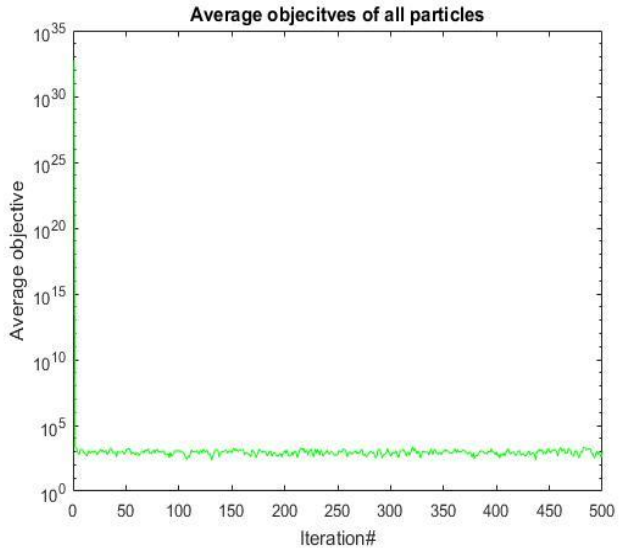

Figure5. Average objectives of the features

From the linear discriminant analysis, the feature points are extracted. The overall objective mean or the average is being plotted. The concurrency maintained by the all parameters is averaged and plotted with respect to number of iterations.

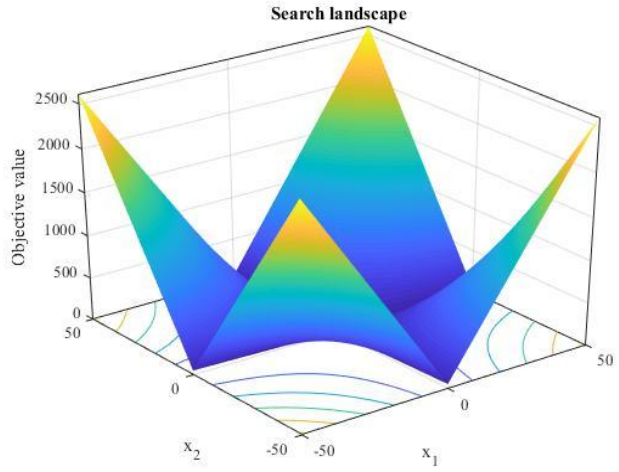

Figure 6. Landscape plot of Search Process

The above depicted plot shows the three dimensional and equally divided search objective values in Surf plot. The plot concerns the relativity of the data after applying with particle swarm optimization process which adaptively route the nodes.

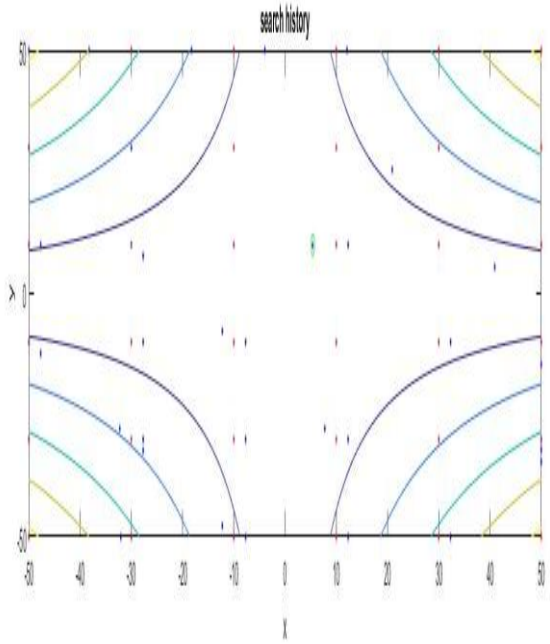

Figure 7. Search history

The above depicted plot shows the direction and coverage of the data which relatively search modelled in the xy plane of the equally spread nodes. The nodes and the path are adaptively change its path when the weight updates at every instant of time. The plot shows the search history of the nodes to be connected.

VI. Conclusion

Thedimensional transformation provides various techniques, which can be implemented to various tasks in signal processing. If the ECG data becomes more complex the drawbacks in sensor communication network degrades the data. This LDA technique changes its transformation. The aim of this research is to reduce the end to end delay of the signal transmission. To achieve this Matlab based configuration algorithm is developed here. In future the research work is further developed with the help of IoT based implementations and real time delay analysis on IoT devices

May – June 2020
ISSN: 0193-4120 Page No. 333 - 337

References

[1]. Karpagachelvi, S., M. Arthanari, and M. Sivakumar. "ECG feature extraction techniques-a survey approach." *arXiv preprint arXiv:1005.0957* (2010).

[2]. Boumbarov, Ognian, Yuliyan Velchev, and Strahil Sokolov. "ECG personal identification in subspaces using radial basis neural networks." *2009 IEEE international workshop on intelligent data acquisition and advanced computing systems: technology and applications*. IEEE, 2009.

[3]. Wang, Yongjin, Konstantinos N. Plataniotis, and Dimitrios Hatzinakos. "Integrating analytic and appearance attributes for human identification from ECG signals." *2006 Biometrics Symposium: Special Session on Research at the Biometric Consortium Conference*. IEEE, 2006.

[4]. Yeh, Yun-Chi, Wen-June Wang, and Che Wun Chiou. "Cardiac arrhythmia diagnosis method using linear discriminant analysis on ECG signals." *Measurement* 42.5 (2009): 778-789.

[5]. Shinwari, Muhammad Fahad, et al. "Classification algorithm for feature extraction using Linear Discriminant Analysis and Cross-Correlation on ECG signals." *International Journal of Advanced Science and Technology* 48 (2012): 149-162.

[6]. Agrafioti, Foteini, and Dimitrios Hatzinakos. "ECG based recognition using second order statistics." *6th Annual Communication Networks and Services Research Conference (cnsr 2008)*. IEEE, 2008.

[7]. Lin, Yue-Der, and Yu Hen Hu. "Power-line interference detection and suppression in ECG signal processing." *IEEE Transactions on Biomedical Engineering* 55.1 (2007): 354-357.

[8]. Martis, Roshan Joy, U. Rajendra Acharya, and Lim Choo Min. "ECG beat classification using PCA, LDA, ICA and discrete wavelet transform." *Biomedical Signal Processing and Control* 8.5 (2013): 437-448.

[9]. Li, Ming, and Shrikanth Narayanan. "Robust ECG biometrics by fusing temporal and cepstral information." *2010 20th International Conference on Pattern Recognition*. IEEE, 2010.

[10]. Vimalarani, C., R. Subramanian, and S. N. Sivanandam. "An enhanced PSO-based clustering energy optimization algorithm for wireless sensor network." *The Scientific World Journal* 2016 (2016).

[11]. Thakur, Meetali, and Parvinder Singh. "WIRELESS BODY AREA NETWORK (WBAN) FOR HEALTH MONITORING SYSTEM USING GENETIC ALGORITHM AND FUZZY LOGIC." *International Journal of Advanced Research in Computer Science* 8.8 (2017)

[12]. Wang, Dongshu, Dapei Tan, and Lei Liu. "Particle swarm optimization algorithm: an overview." *Soft Computing* 22.2 (2018): 387-408.

[13]. Qu, Yating, et al. "A survey of routing protocols in WBAN for healthcare applications." *Sensors* 19.7 (2019): 1638.

[14]. Preethika, Piramu SK, and R. Gobinath. "Alleviation of void and energy hole in mobile cloud offloading using hybrid behavioral intelligence." *Periodicals of Engineering and Natural Sciences* 6.2 (2018): 201-209.