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Original Article

Energy Efficient Clustering using Binary Coded Tournament selection based Genetic Algorithm

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Abstract - *Wireless sensor Network (WSN) now finds a plethora of sectors in which to collect data and monitor both physical and environmental functions. The most significant challenge we confront in WSN is energy usage and life span. The energy delivered to sensor nodes through the battery adds to the complexity. The demand for energy-boosting approaches is growing. This study aims to provide a routing protocol that is energy efficient. The method aids in lowering the energy consumption of sensor nodes in a dispersed network field. Based on a binary-coded tournament selection genetic algorithm, the LEACH Protocol minimizes energy consumption and increases network lifetime. The propound technique simulation outperforms other systems like LEACH, LEACH-GA, LEACH -GADA, LEACH-C, and SEP.*

Keywords - *WSN, Binary Coded Tournament selection, LEACH.*

1. Introduction

Wireless systems have played an important role in research and application in the automation field for several decades. In a WSN, "N" sensor nodes are distributed across the network to observe and transmit data [1]. Node is provided with its energy sources [1]. As an outcome, energy boost techniques and network range are critical in WSN. Node clustering is the most efficient and widely used method. Based on network structure, routing protocols are classified into three types: Data-centric, Hierarchical structure, most nodes in a [2] data-centric system are assigned the same function in location-based and deal with the same data [4]. In location-based data transmission, the place of sensing devices and the routing path are predetermined, increasing power consumption. As nodes are connected to CH, hierarchical routing divides them into clusters, each with its CH control node and CM cluster member. Sampling a ch node (CH) and establishing a cluster are the most important tasks in a hierarchical routing protocol [7].Data will be sent from BS to CH first. Following that, CH will send the data to CM. CH is crucial for determining the best data transfer path, which is then used to save energy. Heinzelman et al. [10] investigated the LEACH algorithm, a less-power adaptive-based clustering hierarchy algorithm in which clusters are formed supervised, and local clusters save energy [16]. Local nodes serve as local clusters,with cluster heads chosen at random. The cluster head will consume more energy than the normal node [10].

The energy balance is achieved by selecting different cluster heads and data aggregation in cluster heads. Xu.j.Jin et al. [12] Introduce LEACH-C;the disadvantages of LEACH can be rectified by selecting CH along with node information like location and energy. CH is preferred based onthe least amount of spanning tree techniques. Its performance is better in terms of network longevity. In LEACH-GA[14], CH is selected based on optimal probability. LEACH-GADA will increase the network lifetime by introducing relay nodes between CHs and BS [16]. Kumar etal. [18] surmised that nodes are provided with supplementary energy resources distributed randomly. Here is the effect of hierarchically hetero-genetic node and their energy level [22].

2. Grading Protocol

2.1. LEACH-GA

Cluster heads are elected in LEACH-GA with the best cluster head probability in GA. During the preparation process, each node in the network will be assigned a CH using the LEACH procedure [24]. The NODE ID and other information will be sent to every node and BS. The genetic algorithm will obtain the precise probability value for the cluster head (Sopt)[16]. The (Sopt) value is sent from BS to all other nodes Liu etal., to decide the best ideal worth value (Sopt) for the CHs[26].

2.2. GADA-LEACH

Distance awareness is achieved in GADA-LEACH [16] by positioning a routing relay node between the source and the CHs. The relay can save energy and make contact between the CH and the source simpler. The ratio of all node energy to CHs energy is calculated using the fitness function. The proportion of the Euclidean distance among CH and the total number of clusters linked. Cluster heads are chosen with GA in LEACH-GA and LEACH-GADA[28,30]. Using a probability technique[35,36], CH selection can be done efficiently. Two factors primarily determine the effectiveness of a wireless sensor network:

- The distance among both CHs and BS in a cluster network.2) The distance with both CH and CMs. In TSGA, we added an enormous number of relay nodes between CHs and sinks and between CH and BS to allow faster communication.[32]

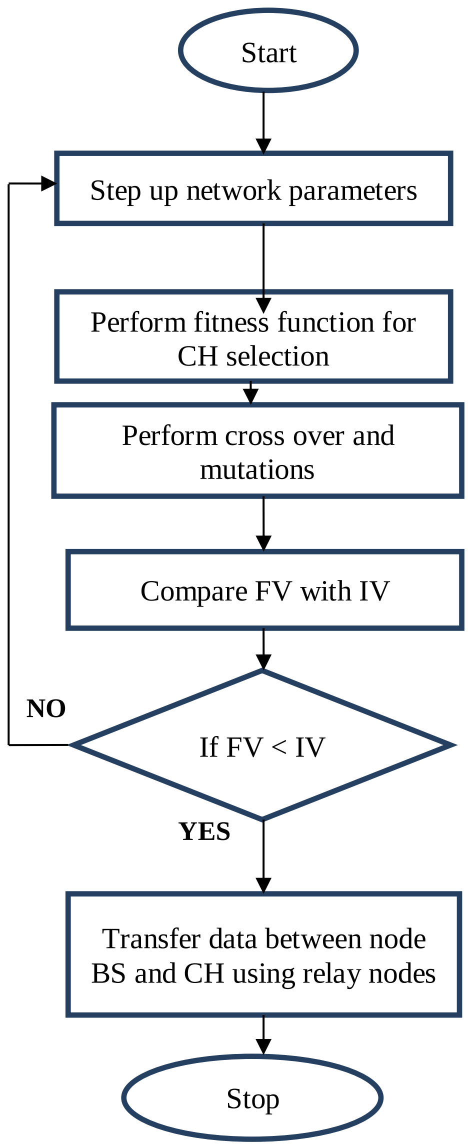

Fig. 1 Flow chart of LEACH-GA

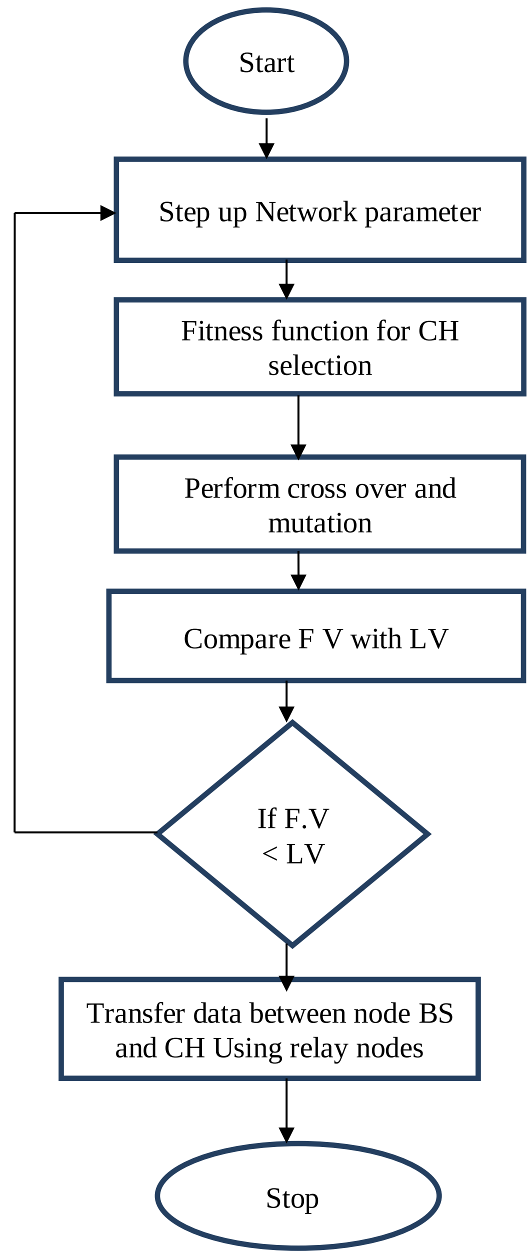

Fig. 2 Flowchart of GADA-LEACH

3. Proposed Method

The head of the LEACH-GA and LEACH-GADA clusters is elected with GA. The probability technique can be used to select CH effectively. Two factors primarily determine the performance of the WSN.

- Distance between CHs and BSs in a cluster network
- Distance between CHs and CMs in a cluster network

In TSGA, we added a huge quantity of relay nodes between CHs and sinks and between CH and BS to facilitate faster communication. It can understand by Equation from 1-3.

$$ET(X, d) = X * Eele + X * SD * d2 \quad (1)$$

$$ET(Xz, d) = X * Eele + X * LD * d4 \quad (2)$$

$$ETRX + X * Eele \quad (3)$$

Where,
ET (X,d) = Total transmitted data over X-Bits
ETRX = Total energy received

2.3. Algorithm

1. Configure the Network and GA parameter
2. Start the iteration with less number of generations.
3. Find the best individual among the node using the tournament selection method.
4. Perform leadership to find the best value
5. Compute fitness function based on best value
6. Preparation phase
   If Q <T(N)
   If (1,i) > min
   CH(s) True
   Else
   Relay True
   End if
7. Setup Phase
   If(CH(s)) = True the
   Broadcast (adv) CM
   Join(ID)
   Location (N)
   Cluster (C)
   Else go to step 4
   End if
8. Steady state phase
   If(CH) = CM(S)TRX(ID,Packets)
   End if. If(CH)=CM(s)
   TRX(ID,Packets)
   Aggregate (ID,Packets)
   TRX to BS (ID,Packets)
   BS to CHs (ID,Packets)
   CHs to BS (ID,Packets)
   End if

4. Simulation and Results Discussion

Our propound algorithm is simulated with the help of MATLAB tool, and simulation parameters are listed in Table1.The implementation of propounding method uses TSGA. I had spitted into two framework

- Framework 1:Size of Packet
- Framework 2:Initial energy

4.1. Frame Work 2: Size of Packet

Fig. 3 depicts the start node that died at various levels of rounds. In TSGA-LEACH, the starting node died at 13640. Compared to other algorithms, the improved network lifetime and energy consumption reduction.

Analysis of ADQN-FLNN model we take 70% from training dataset-1,2,3 Accuracy ,Precision and F-Score has a percentage of 97.72,93.54,92.95 & 98.32,95.57,95.87 and 99.47,97.94,98.1.

Table 1. Values of Network

Parameters	**Values**
Area & Nodes	$100m^2$ & 150
Initial energy	0.2 J/Node
Data packet size	1000 bit
Methods	LEACH, LEACH-GA, LEACH-C, GADA-LEACH, SEP TSGA-LEACH
Highest iterations	20
Rounds	1000

size of packet:1000 bits

Table 2. Routing protocols for 1000-bit packets

Node that is no longer active	F D N	H D N	L D N
LEACH	662	1014	3186
LEACH-C	1426	1694	3382
LEACH-GA	2322	8678	22638
SEP	6723	12648	26134
GADA-LEACH	9112	14572	34134
TSGA	6723	12648	26134

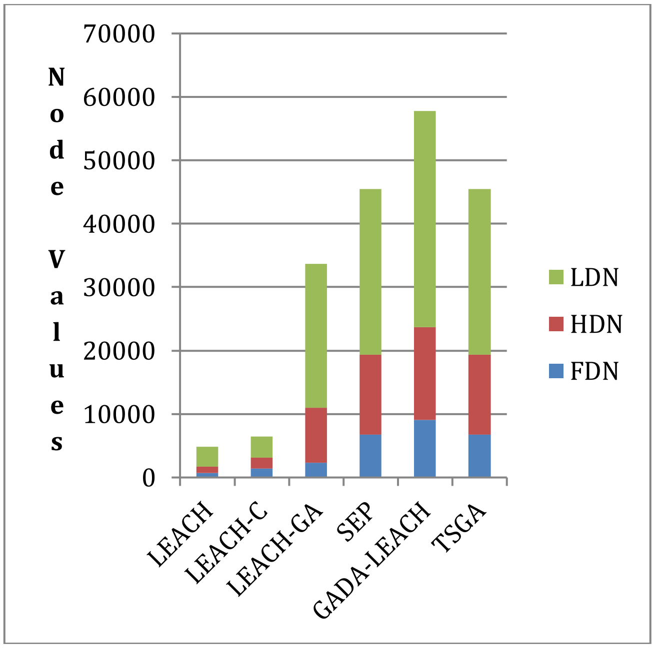

Fig. 3 Routing protocols for 1000-bit packets

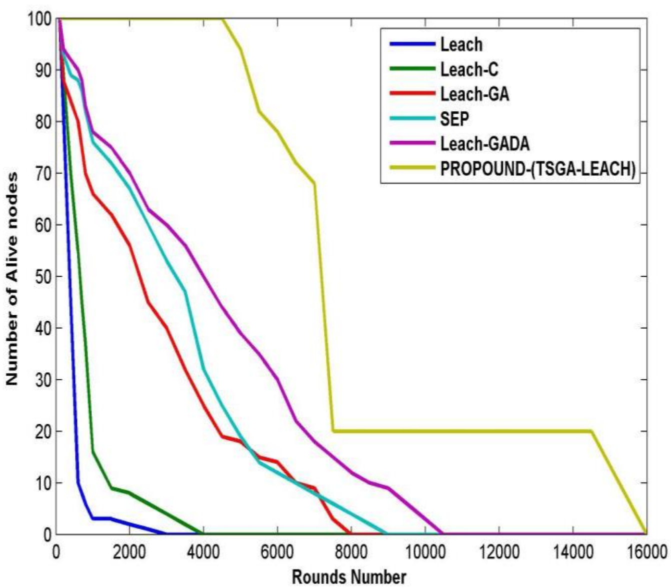

Fig. 4 Lifetime of Node network

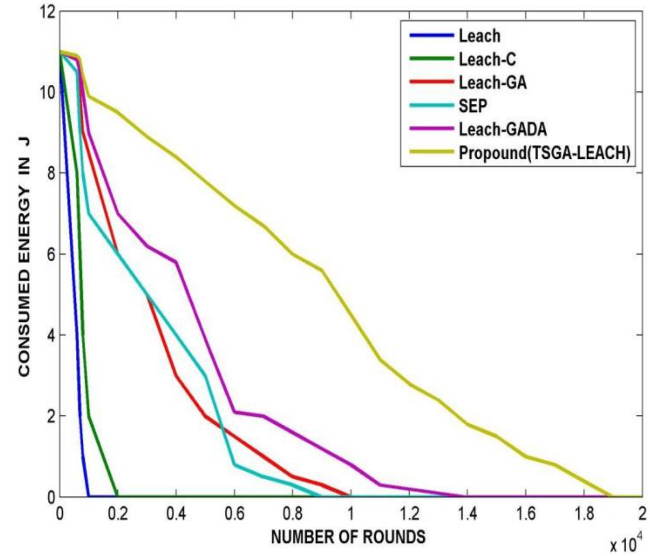

Fig. 5 Energy level of network

4.2. Frame Work 2:Initial Energy

Fig. 6 indicates the death of the first node at various round levels in routing protocols. The first node died at 576, 1120, 1818, 3642, 7198, and 12476. And finally, network lifetime is increased, and reduce energy consumption compared to other protocols.

Table 3. Protocols for routing with an initial energy of 0.2 J/node

Node that is no longer active	F D N	H D N	L D N
LEACH	576	814	2307
LEACH-C	1120	1370	2978
LEACH-GA	1818	6954	14974
SEP	3642	9758	11864
GADA-LEACH	7198	11602	26682
TSGA	12476	14554	29096

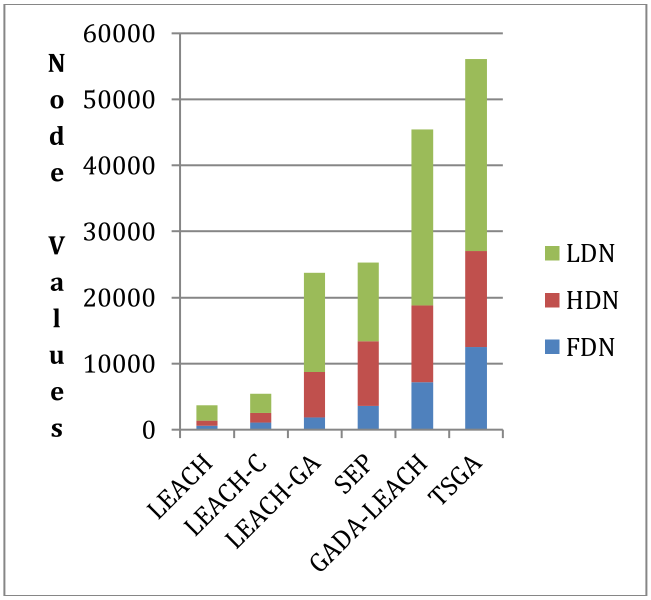

Fig. 6 Initial energy 0.2 J/node

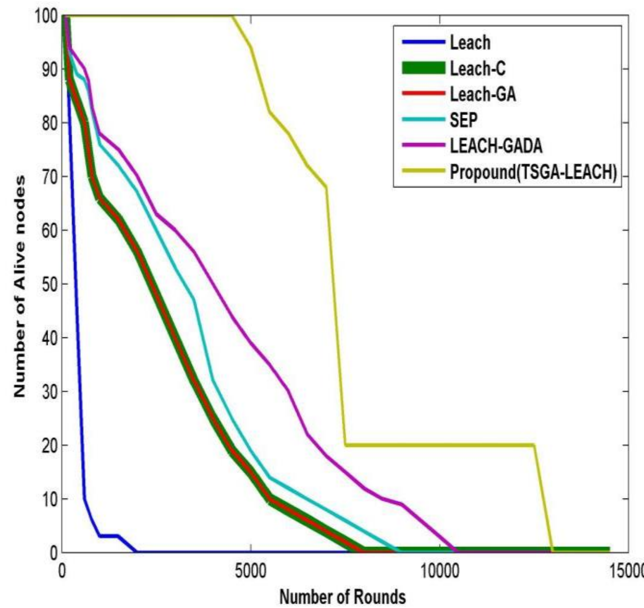

Fig. 8 Lifetime of the node in the network

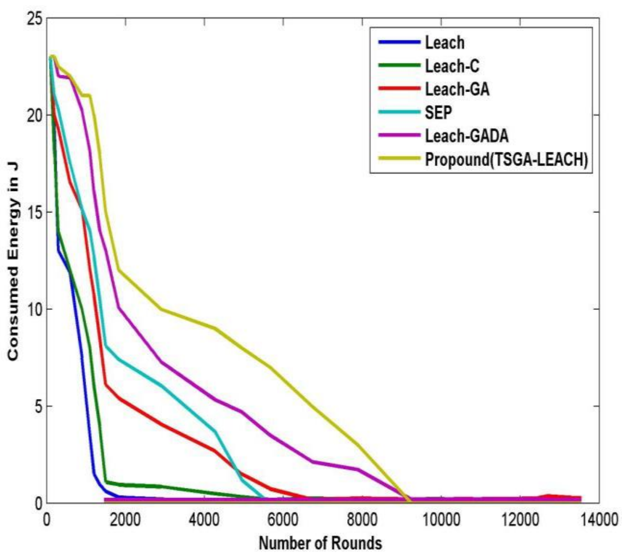

Fig. 7 Various routing protocols' energy consumption

5. Conclusion

The above work shows that the TSGA-LEACH protocol performs better based on Tournament selection cluster head selection.It enhancesthe lifetime & energy consumption of networks.The TSGA-LEACH protocol improves lifetime by 94.01%, 90.52%, 53.1%, 58.43%, and 19.8% over LEACH,LEACH-C,LEACH-GA,SE,LEACHGADA, and TSGA- LEACH for energy levels of 0.2 J/Node. The TSGA-LEACH protocol improves lifetime by 94.43%, 90.62% , 53.82% , 59.03%, and 20.31% over LEAH,LEACH-,LEACH-GA,SEP,LEACH-GADA and TSGA- LEACH. Here we came to know that TSGALEACH outperforms other LEACH-based routing algorithms. Our Propound work will be expanded to include an analysis of the border safety system.

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