Abstract

The main objective of this paper is to balance the load among the dissimilar clusters in the network such that lifetime of the network is improved by using Load Balanced Clustering Algorithm (LBCA). In previous algorithm, no relay node is represented to control the network for balancing the load among the clusters. In LBCA, the nodes are grouped into clusters such that network is controlled by the gateway instead of cluster head. This enhances the performance of the network. Load balanced clustering algorithm, improves the communication among dissimilar sensors in the network. To analyze the effectiveness of the technique, the performance of WSNs spread over numerous dissimilar routing procedures are considered. Simulation results indicate that regardless of the routing process used, our method improves the network lifetime. The proposed algorithm improves the performance and success analysis chart and Energy analysis chart, when compared to GA.

Keywords: Clustering, Genetic Algorithm, Load Balancing, Performance Wireless Sensor Network (WSN)

1. Introduction

In current ages, sensing strategies has established attention from the research civic. Wireless Sensor Networks (WSNs) can rise the effectiveness of many services and public applications, such as battle field observation, safety and tragedy organization where conservative methods shown to be very expensive and dangerous\(^1-4\). Sensor nodes are applied in various circumstances such as: pressure, temperature, motion etc\(^5\). The functionality of the nodes depends on its energy. If the power of a node gets drained it indicates the end of the lifetime of that node.

Data processing and communication abilities are equipped using sensors. Sensing circuit converts parameters into electric signal. These parameters are measured from the environmental surroundings\(^6\). The base station must be statically placed in the locality of the network such that it can gather the data from the sensor nodes\(^7\). To overcome the communication overhead, the highest energy node acts as the gateway which gathers data from all the sensor nodes and transmits the collected data to the base station\(^8\).

The main limitation of the Wireless Sensor Networks is the restricted and irreplaceable power sources of the sensor nodes. In many applications, if the energy of the sensor node gets exhausted, it cannot be replaced easily. So, in such cases consumption of energy is the challenging issue for the extended the lifetime of the WSNs\(^9-11\).

The efficient method for saving the energy is clustering. In cluster based design, the sensor nodes are assembled into separate clusters. Each cluster has a cluster head and every sensor node fit into one cluster. The cluster head gathers and route the confined data from their associate sensor nodes and forward it to the sink directly\(^10\). In order to perform data aggregation only one cluster head per cluster gets involved such that it decreases the consumption of energy. In a cluster, sensor nodes communicate only with their respective cluster heads which can reduce the consumption of communication bandwidth\(^12\). Management of various clusters can be performed easily because only a small routing table is required\(^13\).

The architectural framework for genetic algorithm is shown in Figure 1. In this initially nodes are deployed randomly over a particular region. In that region, nodes are

\(^*\)Author for correspondence
organized into various clusters based on node's energy. In each cluster, the maximum energy node is selected as the cluster head. In a cluster, if its cluster head fails, then the next highest energy node is elected as the gateway. It acts in the same way as that of cluster head. The fitness function is enhanced by applying the genetic algorithm. In each cluster, the load of the cluster head is balanced by using fitness function. By enhancing the fitness function, the performance and lifetime of the sensor nodes are improved. To save energy consumption for sensor networks, an optimization tool has been proposed which is called genetic algorithm and an appropriate fitness function has been developed. All application-specific requirements can be satisfied by using the genetic algorithm which constructs the optimal sensor network designs, fulfill the existent connectivity limitations and incorporate conservation of energy characteristics.

To improve the network lifetime, higher power relay nodes can be used as cluster heads in two-tiered sensor networks. In order to route data towards the base station, the cluster head may form a network. The network lifetime is determined mainly by the lifetime of these cluster heads. An energy-aware communication approach can greatly prolong the lifetime of such networks. To extend the lifetime of a relay node network, genetic algorithm is used for scheduling the data gathering of relay nodes. Global optimum can be determined for smaller networks.

LEACH is a cluster based routing technique, which is used to extend the lifetime of network until the Last Node Dies (LND). Stable Election Protocol (SEP), improves the stability time until the First Node Dies (FND). There is a tradeoff between improving the time until first node dies and the time until last node dies. As single hop routing is inefficient, robustness cannot be achieved. So, in order to achieve robustness, routing protocol is used.

Clustering is an effective topology control technique which adjusts the load of the sensor nodes and enhances the overall scalability and the life time of the remote sensor systems. Cluster heads spend more energy because of additional work burden. Novel Differential Evolution (DE) based clustering algorithm improves lifetime of the network by preventing the early death of the highly overloaded CHs. Local improvement phase is used for faster convergence and better execution.

GA based clustering algorithm includes load balancing of the CHs and it also works for both the equal and unequal loads of the sensor nodes and it produces efficient results. Low-Energy Adaptive Clustering Hierarchy (LEACH) is one of the genetic algorithm based technique which is used to enhance the lifetime of wireless sensor networks. The method consists of 2 phases like Set-up and Steady-state phase. In the set-up phase, the clusters are formed and they are not altered throughout the network. The clusters are not recreated for every round. In static clusters, for every round, cluster heads are changed dynamically. So, it consumes extra energy.

In the previous schemes, the fitness function has not been implemented to enhance the network lifetime. Thus, in the proposed system the performance of the network is improved by applying the load balanced clustering algorithm.

### 2. Proposed System

In previous methodologies, the fitness function is evaluated by using the standard deviation. In order to enhance the performance, performance metrics are included in the fitness function.

#### 2.1 WSN Initialization

In WSN, the nodes are deployed arbitrarily in a target area. Each node has its own energy and position. The highest
3. Load Balanced Clustering Algorithm

I. Number of Sensor Nodes is represented by $S_n$ and Sensing Range $S_r$

II. Number of Gateway is represented by $G_n$ and is to be guarded for $S_n$ for each $G_i$ to $S_i$

III. Traffic load $d_i$ contributed by a sensor node $S_i$ where $S_i \in S$

IV. Load balanced Equal Cluster Formation $C_1 \ldots N$ is done based on traffic load $d_i$

V. Let $L_i$ be the load of the cluster head $C_i$. Then the overall maximum load of each cluster head is $L = \max\{L_i \mid \forall C_i \in C\}$.

VI. Fitness Function $F = \sqrt{\frac{(W_n + W_g) - \mu * Png}{T_n + T_g}}$ is evaluated to detect the Quality of each nodes, where $W_n$ is the weightage of each node, $W_g$ is the weightage of each gateway, $T_n$ is the total number of member nodes, $T_g$ is the total number of gateway, $Png$ is the performance of active node and gateway, $\mu$ is the average load.

VII. Quality nodes $F(S_i) > F$ are estimated and Routing is done

4. Experimental Setup

Performance is improved by enhancing the fitness function.

4.1 Environmental Setup

Trials are attained to on impersonations with 100 devices consistently scattered in a $500 \times 500$ square meter region. Each node is relied upon to consume a starting force of .5 joules and a buffer for up to 20 packets. A node is measured dead in the event that its energy level touches 0 joules. The great scope of the nodes is situated to 100 meter. Scope of the gateways is measured sufficient to cover the whole range under deliberation. Packet measurements are altered to 10 MB for information packets and 2 MB for routing and energize packets. Nodes are given IDs in unpredictable style. The devices in a gathering can be in single of four conditions: sensing, transferring, sensing-relaying, and dead. In the sensing, the device sensing circuit is on and it coordinates measurements to the gateway in a simultaneous evaluation. In the transferring, the device
does not insight the target yet its frameworks hardware is on to transfer the insights from other dynamic devices. At the point when a device is as one sensing the target and handing-off interchanges from different systems, it is measured in the sensing-relaying. At that point, the node is measured inactive and can turn-off its identifying and correspondence electrical framework. Gateways can change the condition of the devices with respect of the routing technique reused.

5. Performance Results

Figure 3 shows the Energy conservation rate analysis chart shows the initial energy of the all nodes, average energy of all nodes using LBCA is higher when compared to average energy of nodes using GA.

Table 1. Transmission

| Method | Number of transmission | Successful transmission | Failure transmission |
|--------|------------------------|-------------------------|---------------------|
| GA     | 150                    | 120                     | 30                  |
| LBCA   | 150                    | 140                     | 10                  |

Table 1 describes about Transmission. The percentage of failure transmission in GA is 20%. The percentage of failure transmission in LBCA is 6.66%. So, the decreasing percentage of failure transmission is 13.3%

6. Conclusion

In this paper, genetic algorithm based load balancing clustering for wireless sensor network has been proposed. This algorithm mainly executes well for even and uneven loads of the sensor nodes in the sensor network. The various methods defined in this paper are WSN initialization, clustering and CH selection process, replacement of CH by gateway in case of failure, load balanced clustering. When the performance of proposed system is evaluated, the numbers of transmission failures are lower than the previous scheme. The dead nodes of LBCA get decreased to 13.27% when compared to that of GA.
7. References

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