RECONSTRUCTION OF TOPOLOGY USING RABC ALGORITHM IN WIRELESS SENSOR NETWORKS

R.S. Raghav and Dhavachelvan Ponnurangam
Department of CSE, Pondicherry University, Pondicherry

ABSTRACT

A wireless sensor network is a cluster of minimal cost and power with multifunctional and small size widely spread sensors. These sensors are operated together to sense the environment and collect the information about the environment in an effective way. The planners of WSNs finding many difficulties such as communication link failures, energy and security related issue. In this work we are going to propose an RABC (Recon Artificial bee colony optimization) and to deploy an efficient way for re-constructing the network topology by using ABC of wireless sensor networks. The advantages of using this algorithm are to improve data transmission between nodes, coverage rate and lifetime of the network.

Keywords: Topology Reconstruction, Artificial Bee colony, Wireless Sensor Network


1. INTRODUCTION

One of the promising technologies in the present world is Wireless sensor network (WSN). The key role of sensor in different environment is highly remarkable, where it has the tendency to collect all kinds of information from dynamic changing environments without any human interference [20, 21, 22, 23]. The small size sensors are used in effective way in variety of applications such as networking, electronics and for processing the collected information. The WSN research carried in many fields for forecasting systems, collecting information and environmental observation etc. In these applications, many low amounts of power and low cost sensor nodes are deployed in a distributed space to form as a network. The role of WSN in present world is massive but they face some obstacles [1].

One of the main issues in WSN is the energy related problem; this is due to improper placement of nodes in a network [24, 25, 26, 27]. It also includes other problems like most of the sensor works using batteries as main source of power supply. If the sensor doesn't place in proper environment, the energy consumption will be more. The security, localization and node deployment related problem also one of the complex task which is also consider as an
obstacle. These are some problems in WSN communication which should be solved in a quick way. If the placement of nodes in network is done in a wrong way, the consumption of energy for communication between the nodes will be high. This leads to many issues such as delay, quick energy drain and low computation [28, 29, 30]. The cost of energy for transmission 1 Kb for distance of 100 meters is approximately. Thus, minimizing the consumption of energy will give an effective communication in network [6]. The deployment of nodes is one of the major constraints in WSN; the topology design should be managed effectively by understanding the key factors of nodes. Some of the key factors are node deployment both in sparse and dense region, residual energy of each node in the topology. The Coverage is one of the main constraints for monitoring the wireless environment. The monitoring environment is covered by at least one sensor node to have minimum connectivity and it is directly connected to the sink node or intermediate nodes are used for indirectly connection. It is highly difficult task to find the solution for energy consumption because it is unsuitable to keep on changing the battery especially if wireless topology is installed in inaccessible areas. Once the node faces energy depletion, the transmission of data will be reduced due to insufficient power. This situation leads nodes to retransmit which causes delay and dropping of packets. The transmission distance also affects the energy depletion; it is another key issue to be considered [3]. Sensor nodes can be deterministically or randomly deployed. The deployment of Deterministic sensor node is carried when the cost of sensor is high or the operation of sensor is significantly affected by their locations. The placement of sensor nodes should be properly placed in the location according to certain requirements. On the other hand, distribution of sensor nodes in a random way is suitable for clumsy environment. However, the drawback of random deployment doesn't provide coverage and accuracy [7]. This paper introduces a deterministic sensor node deployment algorithm for monitoring and quick reconstruction of topology at the time of node related problems.

2. RELATED WORKS

Hashim A.Hashim , B.O.Ayinde , M.A.Abido [1]proposes an enhanced deployment algorithm based on Artificial Bee Colony(ABC).This algorithm deployment is provides increases life time of network by optimizing parameters and it also provides a clear idea for deploying the nodes in the network. Taekkyeun Lee , Chunming Qiao, Murat Demirbas, Jinhui Xu helps WSN to achieve quick and energy saving message delivery by proposing ABC. Here they have a simple geographic forwarding scheme for easy communication bypassing routing holes [2]. The ABC used as a lightweight and reliable routing protocol, which doesn’t require to routing tables. The routing is done by “Angled relaying” mechanism for passing the message in network an efficient way and it reduces retransmission in the network. Yao Liang, Rui Liu design approach to improve the routing scheme with effective communication of message. It has the ability of carrying control over topology at the time of attacks. The load balancing is enabled after the attack is removed from the network [3]. Aminuddin Zabi, Touseef Yousuf and Aparna Manikonda [4] presented a new method for handling some major functionality in topology such as controlling and maintaining topology in wireless sensor networks. The performance of ENR algorithm is shown by improvising the throughput of the network and increasing of PDR in the network. Hazique Aetesam, Itu Snigdh provides a clear idea about the maintenance of topology and their techniques. The proposed work gives a minute difference between the maintenance of topology and construction of topology in an effective way. It also tries to figure out the exact usage of topology maintenance and control in dynamically changing environment like WSN [5]. Thi-Kien Dao, Tien-Szu Pan_ and Trong-The Nguyen proposes a cABC methodology which comprises of real population. This strategy replaces probability vector updated based on single competition. The main usage of using this type of methodology is to have accuracy, fast access of nodes to have effective
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communication. It also reduces the computational time by consuming low amount of memory in the network [6]. Vibin M Valsalan pronounce artificial bee colony (ABC) algorithm which is mainly used for the deployment of sensor networks. It provides a better performance by enhancing the coverage area of the network. It also helps to consume low amount of energy at the time of communication [7]. Rui Liu, Yao Liang, Xiaoyang Zhong provides an important scheme of WSN routing dynamics, which cannot sufficiently carried by previous methods based on a routing tree model. To overcome some of the issues in WSN topology, so they had an idea to have a novel optimization problem for carrying efficient decoding algorithms. This methodology is uses to recover WSN routing topology in real-time. It use of small fixed-size path measurement attached to each packet [8]. Zhidan Liu, Zhenjiang Li, presents CSPR, a compressive-sensing based approach for carrying path reconstruction in wireless sensor networks. The complete understanding of whole network is represented as a path vector in the space. The path length is usually much smaller than the network size, so encoding technique is used for having an accurate and efficient per-packet path reconstruction [9].

3. PROPOSED WORK

3.1 Proposed Algorithm
In this work we propose for organization of WSNs by considering the deployment area of nodes and topology reconstruction. The exploration and exploitation are two main aspects in population based heuristic algorithms [9]. The key concept of Exploration is to expand the search space, and exploitation is known for finding the optimal solution in a population [17]. To achieve a better optimization performance some of the key points need to be known such as 1) higher convergence speeds 2) not trapped in local optima 3) a self adaptive mechanism is adapted for changing search range related with a cycle number [18].

3.2 Random Placement of nodes in topology
We assume that the deployment of nodes is carried in a random way, without considering the number of nodes or any other metrics such as denser or sparse locations. Due to the improper placement of nodes, the value of energy consumed will be high and the value of energy saved will be low. As said earlier the WSN were exposed variety of attacks because of its open nature, one of the main and harmful attack in WSN is sinkhole attack [11]. These types of malicious node express itself as a legitimate node and it creates an illusion as a safe possible route to the reach base-station. It also attracts the neighbouring nodes to use the routing path frequently, inorder to reach the base station quickly. By using this technique the identification of compromise node or compromise path is carried. The alteration or reconstruction of topology by finding the optimal node using ABC is done effectively [19].

3.3 RABC (Reconstructive Artificial Bee colony Algorithm)
We assume that the origin node and the target node are not malicious or compromised. All of the sensors nodes have the ability to communicate with the other sensors in the network. Once the compromised node or path is identified the Reconstruction of topology is initiated and they are classified into different phases like Initialization Phase and Estimation of Topology [12].

3.3.1 Initialization phase:
In this phase, the initialization of nodes in the network is done. ABC is used for finding the optimal position for node deployment. The proposed Reconstruction Artificial Bee Colony (ReconABC) algorithm is a swarm intelligence method inspired by the intelligent foraging
behaviour of honey bees. The theme of using this algorithm is to solve the dynamic deployment problem of WSNs [13]. The aim of the optimization technique is to maximize the coverage rate of the network and to reconstruct the topology after finding malicious path or node in the network, to improve network lifetime. For all employed bees the initial sources are produced, where it carries the information regarding the source or origin node and destination or target node. It calculates the distance between the nodes in a network.

3.3.2: Estimation of topology:
Once the initial phase is done, the estimation of topology phase is carried in two stages by the employee bee 1. Closest node discovering 2. Updating Topology.

Closest node Discovering:
The regular approaches for topology control in wireless sensor networks uses maximum power transmissions during the closest node discovering phase to find all the close nodes in the network. Once the information about the node is collected, each node will start communication according to its transmission range (or power) [14]. Each node in WSN faces high power consumption when the topology is not properly fixed. Each node starts communicating with low power and it gradually increases the energy level until all closest nodes are interconnected. Each node release hello message to other nodes in the network. The hello message contains node ID and the list of its current closest nodes. For instance N is declared as current node $\rho$ is the transmission power level; S is the global node in the network and $M_s$ is the hello message and it structure is followed by below equation

$$M_s = (M_{ID}, N_s, P_s)$$

Once the node R overhears $M_s$, it saves the ID of the origin node $s$ together with its relative distance $\beta_{sN-r_s}$. This information is received by the target node, by knowing the transmission power at the origin node and the power computed at the target node and the distance. If the range of $M_s$ is smaller than the transmission range used RangeNode_R is included with $M_s$, $\beta_{sN-r_s}$. Otherwise, RangeNode_R is smaller than the Range $\beta_{sN-r_s}$. S\_n cannot hear beacons from R\_ns because the link is not symmetric. The Figure 1 shows the Flow chart of RABC.

Updation Topology:
In this phase topology updation takes place, where all nodes in the network tend to calculate neighbour nodes. If the nodes falls within it transmission range then $M_s$ is updated. The transmission range is increased to cover the distance of non range nodes [15]. The employee bee allocates scout bee to fetch the details of other nodes to cover the remaining nodes and these nodes are declared as critical nodes. The new solutions for the employee bee is generated by using the below equation.

$$NP_{ij} = CP_{ij} + \delta_{ij}(CP_{ij} - CP_{kj}) \text{ where } i \neq k$$

The node which is widely spread and kept away from the range is figure out by using scout bee Memorize the best food source found until all requirements are met.
4. EXPERIMENTAL RESULTS AND ANALYSIS
The Simulation work is carried in MATLAB and the parameters are displayed below and it is carried in two different regions such as sparse and dense region in a network. The proposed model could be validated using a set of existing standard performance factors. The set may contain the following factors: Energy Consumption, Packet Delivery Ratio, Energy Efficiency, End to End Delay, and Network Lifetime. The number of nodes can be assigned in the simulation phase can be up to 1 to 100 nodes. The relay node which is used for carrying the multihop communication can be 5, if the node quantity falls under the range 1 to 10. The initial energy consumed by each node is 100 Joule. The energy consumption rate of the each node for message communication in the network can be 1 Joule/Second. The size of the topology can be placed in area of 500m x 500m. The first phase is carried by using the random deployment of nodes in a topology and the nodes are placed in two regions like sparse and dense. The performances factors such as Energy saved, energy consumed, and lifetime of the network, Packet delivery ratio, and End to End delay and Reconstruction ratio were
evaluated. Once the packet drop is found in the topology the PDR value is also falls into low of both regions. These issues occur when the topology carries random placed nodes. The lifetime of network will be low because of its node deployment and it doesn't have the ability to cover nodes which doesn't appear inside its radius which is displayed in fig 8. So the generic node needs to explore other nodes for effective communication. Here the value of energy saving is less and the energy consumption will become high, this is because the node requires more power for transmitting hello message to other nodes for reconstruction purpose. In the end the main theme reconstruction of topology is not carried in a proper way after detecting malicious node in a path. The fig 2 and fig 3 displays the energy consumption of randomly placed nodes in both sparse and dense region. As we said earlier the random placed nodes doesn't give an appropriate solution for energy consumption, where it consumes more amount of energy or power for message transmission. The fig 4 describes about the energy saved while the nodes are randomly placed in dense and sparse region which is also low. The malicious node interference in path makes the node to have low packet delivery ratio and it is clearly shown in fig 10. According to the previous factors the reconstruction ratio is not achieved properly after finding the path as malicious nodes displayed in fig 12 and its position of nodes. The end to end delay in the network is shown in fig 8, it indicates the random placed of relay nodes couldn’t produce effective results due to the energy related demerits in the deployment. This will help the packet delivery ratio to reach high value when compared to previous phase. The main factor reconstruction ratio is high and quick conduction of topology makes the network to consume less energy and delay by achieving more packet delivery ratio in both dense and sparse region. The fig 13 displays about the reconstruction ratio of topology in dense and sparse region. The lifetime of the network is increased when the relay nodes are placed according to the RABC which is display in fig 9. It consumes less amount of energy, so that the level of energy is not used frequently, which tends to improve the lifetime of the network. It enhances the packet delivery by making all the packets to reach the target even after reconstruction of topology take place. The fig 7 display the end to end delay of the packet transmission which is low than first phase. In second phase RABC is used for reconstruction of topology after finding the interference of malicious nodes in the topology. The RABC construction is shown and the fig 3 describes about the energy consumption of node which tends to be low compared to the first phase. The fig 5 describes about the energy saving of a node in sparse and dense region. Some nodes could not receive the signal or message from the node which has some packet loss and this issue will be overcome by suing RABC. It will reconstruct the topology so that the critical nodes also gain the capacity to involve in the message communication. This will help the packet delivery ratio to reach high value when compared to previous phase.

Figure 1 Energy Consumed by Random placed nodes

Figure 2 Energy Consumed by RABC

Figure 3 Energy Saved by Random placed nodes
The main factor reconstruction ratio is high and quick conduction of topology makes the network to consume less energy and delay by achieving more packet delivery ratio in both dense and sparse region. The fig 13 displays about the reconstruction ratio of topology in dense and sparse region. The lifetime of the network is increased when the relay nodes are placed according to the RABC which is display in fig 9. It consumes less amount of energy, so that the level of energy is not used frequently, which tends to improve the lifetime of the network. The reconstruction of topology is carried with low amount of energy. The fig 11 shows the packet delivery ratio when relay nodes are placed using RABC. It enhances the packet delivery by making all the packets to reach the target even after reconstruction of
topology take place. The fig 7 display the end to end delay of the packet transmission which is low than first phase.

5. CONCLUSION AND FUTURE WORK

In this paper we have proposed an effective Reconstruction topology by using ABC algorithm to find the optimal placement of nodes with the help of employee and scout bee. The planners of WSNs finding many difficulties such as communication link failures, energy and security related issue. In this work we are going to propose an RABC (Recon Artificial bee colony optimization) and to deploy an efficient way for re-constructing the network topology by using ABC of wireless sensor networks. The advantages of using this algorithm are to improve data transmission between nodes, coverage rate and lifetime of the network. The results are compared random based reconstruction and RABC based reconstruction of topology in WSN. The above displayed results show the performance factors of both phases deployed in both sparse and dense region. Our algorithm gives a proper reconstruction of topology with low delay and energy consumption. It also improvise some of the key factors of nodes like energy saving, packet delivery ratio in the network. The proper reconstruction of topology by RABC helps to improve the lifetime of the network. Our future work is to use cryptography algorithm to enhance the security to find the insider attack in the network. It can be compared with other secured algorithms in terms of different performance factors.

REFERENCES


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