

Bee Colony Algorithm based Routing Method for WSN Network

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Abstract

With the progression of computer and network and joining distant location wireless sensor network (WSNs) emerge as a new topic in the world. This research investigates energy-efficient and coverage aware routing protocol using bee colony algorithm. These network deployed in remote locations that processor has limited capabilities and limited power and limited memory capabilities.

Keywords:

Sensor networks, energy efficient, coverage, bee colony

reduced processing capabilities, limited memory capacities, and fixed battery supplies. The WSN energy consumption has three types: sensing, computing, and communicating. Analysis demonstrates that the communications costs dominate a WSN sensor platform's power budget. The WSN networks should be scalable to support extremely dense sensor fields [2]. best routing algorithms allow remote data to be passed reliably through the network to a final control point with minimum energy consumption [3]. To summarize the aims that a node and a network of this nature have to achieve, these are ideally the main characteristics of nodes and WSNs network [4]:

1. Introduction

We are living in the world business that is more mobile and computational applications are widely distributed, wireless networks bridge the gap by making distance and movement seamless. Wireless sensor networks (WSN) consists of one to thousands of homogeneous or heterogeneous sensors that share the information for data collaboration or network data collection sink routing [1]. Remote sensing platforms are typically characterized by

- Low power consumption.
- Low cost nodes that use cheap and commonly available batteries.
- Small physical size to facilitate deployment.
- Compliance to standards and regulations.
- Single design for international markets.

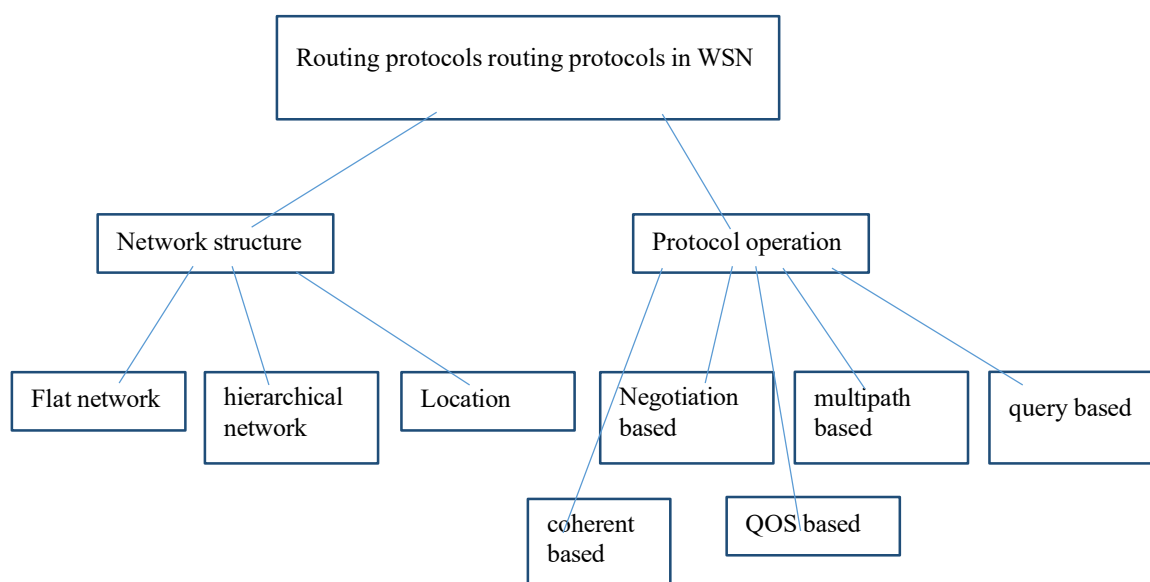


Figure 1: routing protocol

- Ability to maintain time synchronization with other nodes and hopping messages to destination.
- Operate over wide temperature ranges especially for military applications or high temperature scenarios

2. Related Work

The below diagram shows the routing protocol in WSNs network[5]: We have many Classification and comparison of routing protocols in wireless sensor networks that you can see them in below table[5]:

Table 1: comparison routing protocols

	Classifi- cation	Mobility	Position awareness	Power usage	Negotiation- based	Data aggre- gation	Local- ization	QoS	State comp- lexity	Scalab- ility	Multi- path	Query- based
SPIN	Flat	Poss.	No	Ltd.	Yes	Yes	No	No	Low	Ltd.	Yes	Yes
Direct diffusion	Flat	Ltd.	No	Ltd.	Yes	Yes	Yes	No	Low	Ltd.	Yes	Yes
Rumor routing	Flat	Very Ltd.	No	N/A	No	Yes	No	No	Low	Good	No	Yes
GBR	Flat	Ltd.	No	N/A	No	Yes	No	No	Low	Ltd.	No	Yes
MCFA	Flat	No	No	N/A	No	No	No	No	Low	Good	No	No
CADR	Flat	No	No	Ltd.	No	Yes	No	No	Low	Ltd.	No	No
COUGAR	Flat	No	No	Ltd.	No	Yes	No	No	Low	Ltd.	No	Yes
ACQUIRE	Flat	Ltd.	No	N/A	No	Yes	No	No	Low	Ltd.	No	Yes
EAR	Flat	Ltd.	No	N/A	No	No		No	Low	Ltd.	No	Yes
LEACH	Hierarchical	Fixed BS	No	Max.	No	Yes	Yes	No	CHs	Good	No	No
TEEN & APTEEN	Hierarchical	Fixed BS	No	Max.	No	Yes	Yes	No	CHs	Good	No	No
PEGASIS	Hierarchical	Fixed BS	No	Max.	No	No	Yes	No	Low	Good	No	No
MECN & SMECN	Hierarchical	No	No	Max.	No	No	No	No	Low	Low	No	No
OP	Hierarchical	No	No	N/A	No	No	No	No	Low	Low	No	No
HPAR	Hierarchical	No	No	N/A	No	No	No	No	Low	Good	No	No
VGA	Hierarchical	No	No	N/A	Yes	Yes	Yes	No	CHs	Good	Yes	No
Sensor aggregate	Hierarchical	Ltd.	No	N/A	No	Yes	No	No	Low	Good	No	Poss.
TTDD	Hierarchical	Yes	Yes	Ltd.	No	No	No	No	Mod.	Low	Poss.	Poss.
GAF	Location	Ltd.	No	Ltd.	No	No	No	No	Low	Good	No	No
GEAR	Location	Ltd.	No	Ltd.	No	No	No	No	Low	Ltd.	No	No
SPAN	Location	Ltd.	No	N/A	Yes	No	No	No	Low	Ltd.	No	No
MFR, GEDIR	Location	No	No	N/A	No	No	No	No	Low	Ltd.	No	No
GOAFR	Location	No	No	N/A	No	No	No	Low	Good	No	No	
SAR	Location	No	No	N/A	Yes	Yes	No	Yes	Mod.	Ltd.	No	Yes
SPEED	QoS	No	No	N/A	No	No	No	Yes	Mod.	Ltd.	No	Yes

This table presented a survey of WSNs routing protocol. We describe the important of them more in below: In a Sensor Protocols for Information via Negotiation (SPIN) all the information of each node sent to every node in the network assuming that all nodes in the network are potential BSs (base stations). user can to query any node and get the required information immediately in a network [5].

In The Minimum Cost Forwarding Algorithm (MCFA) a sensor node don't need to have a unique ID or maintain a routing table. but, each node maintains the least cost estimate from itself to the BS. Each message to be forwarded by the sensor node is broadcast to its neighbours. When a node receives the message, it checks if it is on the least cost path between the source sensor node and the BS.

If this is the case, it rebroadcasts the message to its neighbours. This process repeats until the BS is reached [5]. a hierarchical clustering algorithm for sensor Networks is LEACH, called Low Energy Adaptive Clustering Hierarchy (LEACH). it is a cluster-based protocol, and includes distributed cluster formation. LEACH randomly selects a few sensor nodes as cluster heads (CHs) and rotates this role to evenly distribute the energy load among the sensors in the network. In LEACH, the CH nodes compress data arriving from nodes that belong to the respective cluster, and send an Evaluation of Wireless Sensor Network Technologies [6].

The protocol, called Power-Efficient Gathering in Sensor Information Systems (PEGASIS), is a near optimal

chain-based protocol. The basic idea of the protocol is that in order to extend network lifetime, nodes need only communicate with their closest neighbours, and they take turns in communicating with the BS. When the round of all nodes communicating with the BS ends, a new round starts, and so on [5].

3. Bee Colony

Biologically inspired computing is a field of study which is related to biology, computer science and mathematics. It uses computers to model nature, and parallel study of nature to improve the usage of computers. Bio inspired computing is a major part of natural computation. It takes bottom-up and decentralized approach. Bio-inspired techniques involve the methods of specifying a set of simple rules, a set of simple organisms which follows those rules, and an iterative method applies to those rules (2012). Bio-Inspired Algorithms can be divided into two classes, namely, Evolutionary Algorithms and Swarm based Algorithms which are inspired by the natural evolution and collective behavior in animals respectively[7].

Swarm Intelligence appears in biological swarms of certain insect species. It gives rise to complex and often intelligent behavior through complex interaction of thousands of autonomous swarm members. Interaction is based on primitive instincts with no supervision. The end result is accomplishment of very complex forms of social behavior and fulfillment of a number of optimization and other tasks. The main principle behind these interactions is called stigmergy, or communication through the environment. An example is bee colony algorithm. The Artificial Bee Colony, introduced by Dervis Karaboga in 2005(2005). The Artificial Bee Colony can solve Constrained Optimization Problem[7].

Engineering design, structural optimization, economics, VLSI design, allocation and location problems are just a few of the scientific fields in which Constrained Optimization problems are frequently met [7]. The colony of artificial bees consists of three groups of bees:

- Employed bees: a bee going to the food source visited by itself previously is named an employed bee
- Onlookers: A bee waiting on the dance area for making decision to choose a food source.
- Scout bees: A bee carrying out random search is called a scout.

The one section of the employed artificial bees and another section include the onlookers. The number of employed bees is equal to the number of food sources. If

food source is exhausted by the employed bees, then onlooker bees become a scout. Detailed flow chart of the ABC algorithm is given below[7]:

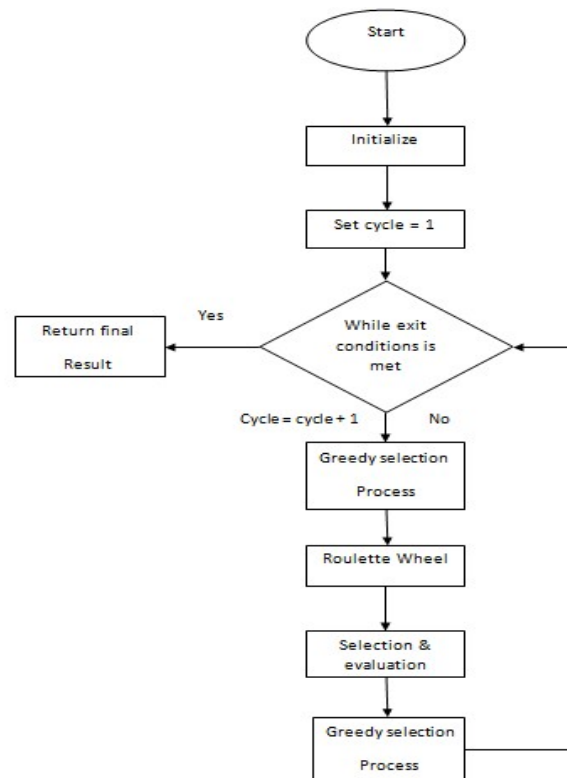


Figure.2. Flowchart of bee colony algorithm

In artificial bee colony algorithm, the position of a food source represents a possible solution to the optimization problem and the nectar amount of a food source corresponds to the quality of the associated solution. The number of the employed bees or the onlooker bees is equal to the number of solutions in the population. The population of the positions is subjected to repeated cycles of the search processes of the employed bees, the onlooker bees and scout bees. An artificial employed or onlooker bee probabilistically produces a modification on the position (solution) in its memory for finding a new food source and tests the nectar number of (fitness value) of the new source (new solution). If nectar number of the new one is higher than that of the previous one, the bee forgets the old one and memorizes the new position. Otherwise, in her memory, she keeps the position of the previous one. They share the nectar information of the food sources (solutions) and their position information with the onlooker bees on the dance area[7]. Bee colony algorithm has advantages like[7]:

- Scalability: Population of the agents can be adapted according to the network size. Scalability is also promoted by local and distributed agent interactions
- Fault tolerance: Bee colony algorithm processes do not rely on a centralized control mechanism. Therefore the loss of a few nodes or links does not result in catastrophic failure, but rather leads to graceful, scalable degradation
- Adaptation: Agents can change, die or reproduce, according to network changes
- Modularity: Agents act independently of other network layers

4. Proposed Method

In our method we have 2 phases: 1-clustering, 2-data transfer. In first phase nodes make clusters and select one of node as head cluster that have three conditions: 1) more residual energy 2) be in a center of cluster 3) be in a near of BS[8]. After clustering we have 2 ways for data transform: 1) in a cluster 2) out of cluster.

In a cluster all of node gathering information and send to cluster head. The other way is out of cluster. If the destination between head cluster and BS was one hop data transformed directly and the otherwise use bee colony.

4.1 Analysis

We use matlab for simulation. The output of ECDC bee colony is in Figure 3.:

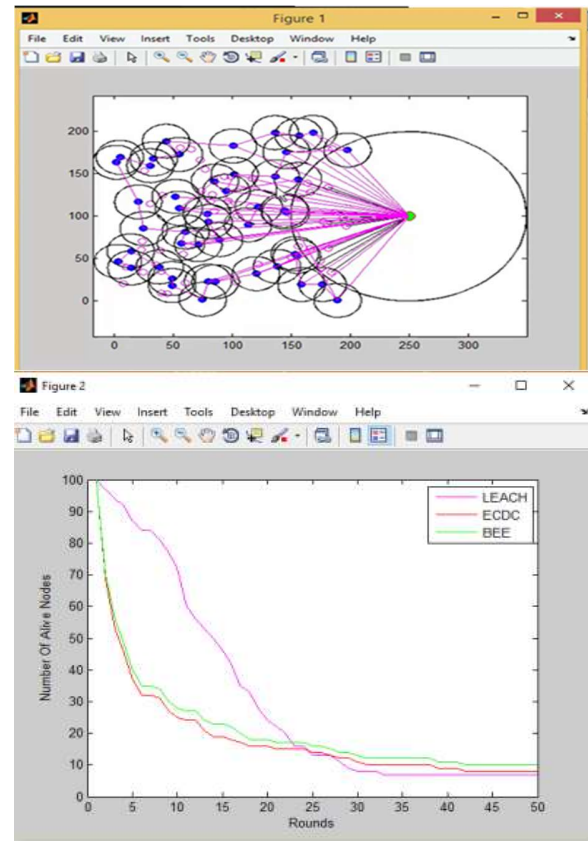


Figure 3. output of ECDC with bee colony
fig4. Remaining power of nodes

The number of alive node is in fig3. in proposed method the number of alive node is more than the other. The remaining power of node shown in below and you can see that in proposed method the remaining of power in nodes are more here.

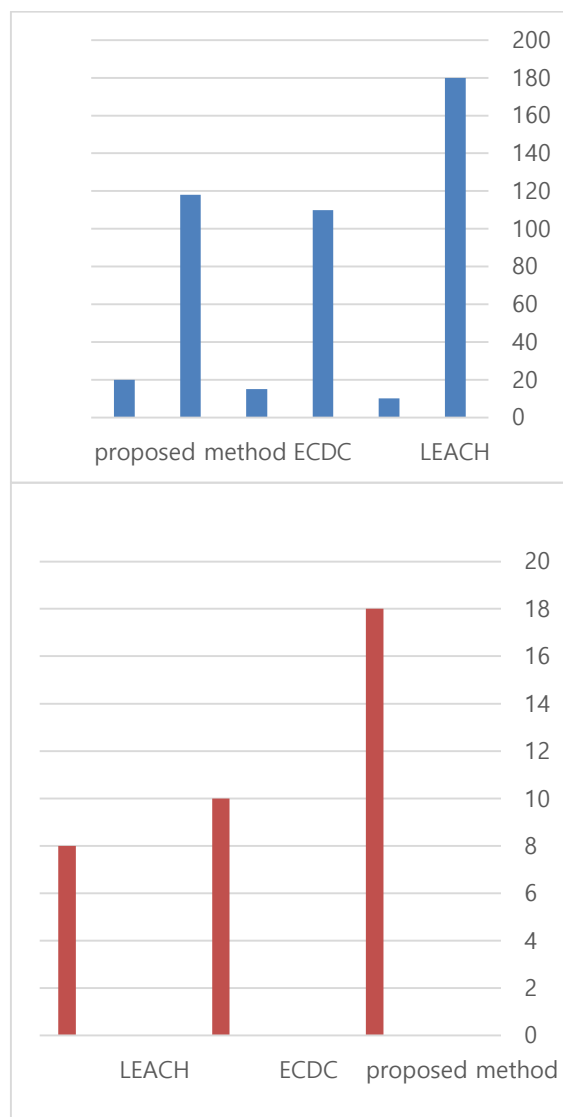


Figure 5. Chart of alive nodes and Chart of remaining power

5. Conclusion

We have many research in WSNs. This is a very useful major because:

- can use in emergense location
- don't need to human maintain

Researchers introduce many routing protocol in WSNs. some of them is energy consumption and the other have more cover. We can work on energy and coveragr in WSNs in future.

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