# Event Based Clustering Localized Artificial Bee Colony (EBC-LABC) Algorithm for Performance Enhancement of Wireless Sensor Network in Disaster Situation

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**ABSTRACT**

*The main objective of perposed event based clustering localized artificial bee colony alorithm is to enhance performance of wireless sensor network (WSN) in disaster stuation. ABC algorithm does not consider location information of nodes, and thus consumes more time in route discovery and selection. To improve overall QoS of the WSN, ABC-RSSI algorithm is based on location information of nodes using received signal strength indicator (RSSI). But in ABC-RSSI each node send information to base satation eventhough information is same, which increse the overheads.*

*The main focus of the proposed algorithm is to improve QoS and minimize the energy consumption of the network by cluster formation and selecting optimal path based on the biological inspired routing- ABC and location information of nodes. In clustering; data is aggregated and sent to the sink (Base Station) through cluster head (CH) which reduces the overheads.*

*EBC-LABC is a scalable and energy efficient reactive routing algorithm which improves QoS, lifetime and minimize energy consummation of WSN as compared to other routing algorithms like AODV, ACO, ABC-RSSI.*

***KEYWORDS: ABC; AODV; CH; Clustering; EBC; LABC; QoS; RSSI; WSN***

## I. INTRODUCTION

WSN consist of number of sensor nodes. These nodes are small in size and have low power capacity. These multifunctional nodes are deployed in a particular area for data gathering purpose. The sensor nodes (SN) pass the data to the sink node using multiple hops as shown in Fig. 1.

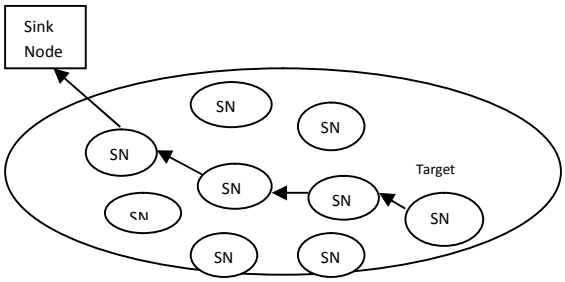


**Fig. 1: Architecture of wireless sensor network**

The requirement in disaster situation is that the sensor nodes should perform the communication without failure for long duration. A traditional routing algorithm does not consider the location information and thus cannot be used in disaster area where stable communication is important. Selection of routing algorithm is one of the major problem of sensor network to be solved [1, 2, 3]. The main goal of WSN routing is to improve QoS, network lifetime and reduction in connectivity failure.

Therefore, an event based clustering localized artificial bee colony algorithm is proposed. The main focus of the proposed algorithm is to enhance QoS as well as to minimize the energy consumption of the network by cluster formation and selecting optimal path based on the biological inspired routing- ABC and location information of nodes.

The rest of the paper is organized as follows: Section 2 presents related work. Section 3, 4 presents present methods and proposed method respectively. Section 5 presents the detailed practical analysis of all the four categories of routing algorithms. Finally Section 6 concludes the paper.

## II. RELATED WORK

In this section, the protocols available till today like classical routing, localization based routing and location based bio-inspired routing are summarized.

### A. Classical Routing Protocols

Classical routing protocols are Proactive, Reactive and Hybrid [4, 5]. Routing protocol have impact on energy consumption behavior of nodes in a network, since mobile nodes in WSN are supplied by battery with limited energy, energy efficiency is a major problem that influences the overall system performance of network. Taking energy into consideration, reactive protocols are more efficient as compared to proactive protocols due to less control overheads. Both proactive and reactive protocols are unaware of energy metrics and hence effect in an easy lowering of the battery energy of the nodes over the most heavily used routes in the network.

### B. Localization Based Routing Protocols

Location information for sensor nodes is needed for sensor networks by most of the routing protocols to calculate the distance between two particular nodes so that energy consumption can be calculated.

According to the dependency of range measurements, the existing localization schemes can be categorized into two major categories:

- Range-based approaches
- Range-free approaches

Range based and range free schemes are again divided into anchor based and anchor free schemes. The anchor-free schemes do not assume that node positions are firstly known. While, the anchor-based schemes need some nodes those are aware about their positions (anchor nodes) to provide geographic information to unidentified nodes to localize [6].

### C. Location Based Bio-inspired Routing Algorithms

Various location based routing algorithms have been proposed, nevertheless they have related shortcoming either not guaranteeing to find a way to the destination or locating a path which is much longer than the shortest path.

Find the locations of nodes by using Particle Swarm Optimization and Artificial Bee Colony algorithm and compare the performance of these two algorithms. The term swarm is used in a general manner to refer to a collection of interacting agents or individuals. Also propose

multi stage localization and compared multi stage localization performance with single stage localization [7].

## III. PRESENT METHODS

### A. Ad-hoc on Demand Distance Vector (AODV) Protocol

As the name itself suggests that Ad-hoc on Demand Distance Vector (AODV) protocol is an on demand routing protocol which means AODV determines a route to a destination only when a node wants to send a packets to that destination [4].

Essential objectives of the algorithm are

- To broadcast discovery packets only when necessary using RREQ message.
- To recognize between local connectivity management, neighborhood identification and general topology maintenance using HELLO message.
- To spread data about changes in nearby availability to those neighboring mobile nodes those are probably require the information using RERR message.

AODV operation is divided into two phases such as:

- Route discovery
- Route maintenance

### B. Artificial Bee Colony

Artificial Bee Colony (ABC) is a swarm intelligence based algorithm which was introduced by Karaboga in 2005. ABC principle is based on natural behavior of real honey bees in "food foraging" [8, 9, 10]. Bee colony consists of three types of bees for food foraging i.e. employed bees (EB) , onlooker bees (OB) and Scout Bee (SB). In the ABC algorithm the number of source nodes, EB and OB is same. In the route discovery phase, when the data is need to be send, sender node broadcasts an EB and it is forwarded by intermediate nodes until it reaches to the destination. When the intermediate node receives EB for first time it updates its own information along with the number of hops the EB needed to reach the node and then forward it to its neighbors. When the EB reaches the destination, OB packet is passed by the destination node towards the source node through the most economical path. In this way number of paths can be discovered and better path among them can be established for data routing. If the route failure occurs then it starts the scout bee phase.

### C. ABC-RSSI

Wireless networks, path selected based on minimal hop count can be easily break because of involvement of wireless links between distant nodes. Therefore it is a better route with shorter distance. In this section, proposed a solution that enables each node in the network to determine the location of its neighbors in order to create a shorter and stable path. For that purpose, calculate the neighbor's distances of a node using the RSSI. RSSI technique is used because it can be implemented on an existing wireless system with little or sometime no hardware changes.

During the route discovery, sender broadcast the employed bee and forwards it to the intermediate node along with RSSI value [11, 12]. When the EB reaches to destination, destination node passes the OB packet towards the source node through the stable path. If the route failure occurs then it starts the scout bee phase. The scout bee searches for the random path based on the RSSI value. Therefore the EB as well as SB will search for a node with a shorter distance using RSSI. These steps will repeat till the termination criteria met.

## IV. PROPOSED METHOD

The main focus of the proposed EBC-LABC algorithm is to minimize the energy consumption of the network by cluster formation and selecting optimal path based on the biological inspired routing ABC and location information of nodes.

### A. Three Steps of Proposed Algorithm

Step 1: Construction of Hop Tree

Each node computes the distance from sink node in terms of hop. The algorithm is initiated by the sink node by forwarding the HCM (Hop Configuration Message) to complete network by means of a flooding. The nodes store the received hop value, increment it and transmit it to its neighbor nodes. This process continues until the whole network is configured. The HCM message contains two fields: ID which is node identifier and Hop To Tree which is the distance in hops [13, 14, 15]. Hop tree formation step is shown in Fig. 2.

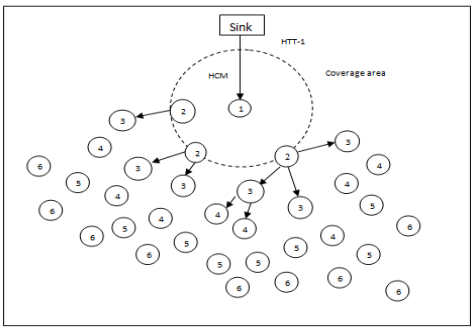


**Fig. 2: Hop Tree formation**

**Step 2: Formation of cluster and selection of cluster head**

When a set of nodes detect an event, they forms a cluster. For cluster head election, all sensing nodes are eligible. CH selection is based on distance of node from sink in terms of hop, remaining energy of node. The node with the smallest ID or the energy level can be selected in case of tie occurs. At the end of the selection only one node in the group will be declared as the cluster head. The remaining nodes that detected the same event will be the members of that cluster. The CH gathers the information collected by the member nodes, aggregates it and sent to the sink.

**Step 3: Route discovery and maintenance**

When the data is need to be send, an employed bee is broadcast by sender and forwarded by intermediate nodes having maximum signal strength value till it reaches to the destination. When the intermediate node receives EB for first time it updates its own information along with the number of hops the EB needed to reach the node and then forward it to its neighbors. When the EB reaches the destination, the destination node passes the OB packet towards the source node through the better path. In this way number of paths can be discovered and better path among them can be established for data routing. If the route failure occurs, EB convert as a SB and search for the alternate path for the destination based on RSSI value. If the alternate path exists, the packet is forwarded on that path. If the SB is unable to have the alternate path, the EB informs its predecessor to relay the packet towards source. On reaching the source, the source can initiates new route discovery phase.

### B. Flow Cart of EBC-LABC Algorithm

Flow Chart of EBC-LABC algorithm is shown in Fig. 3.

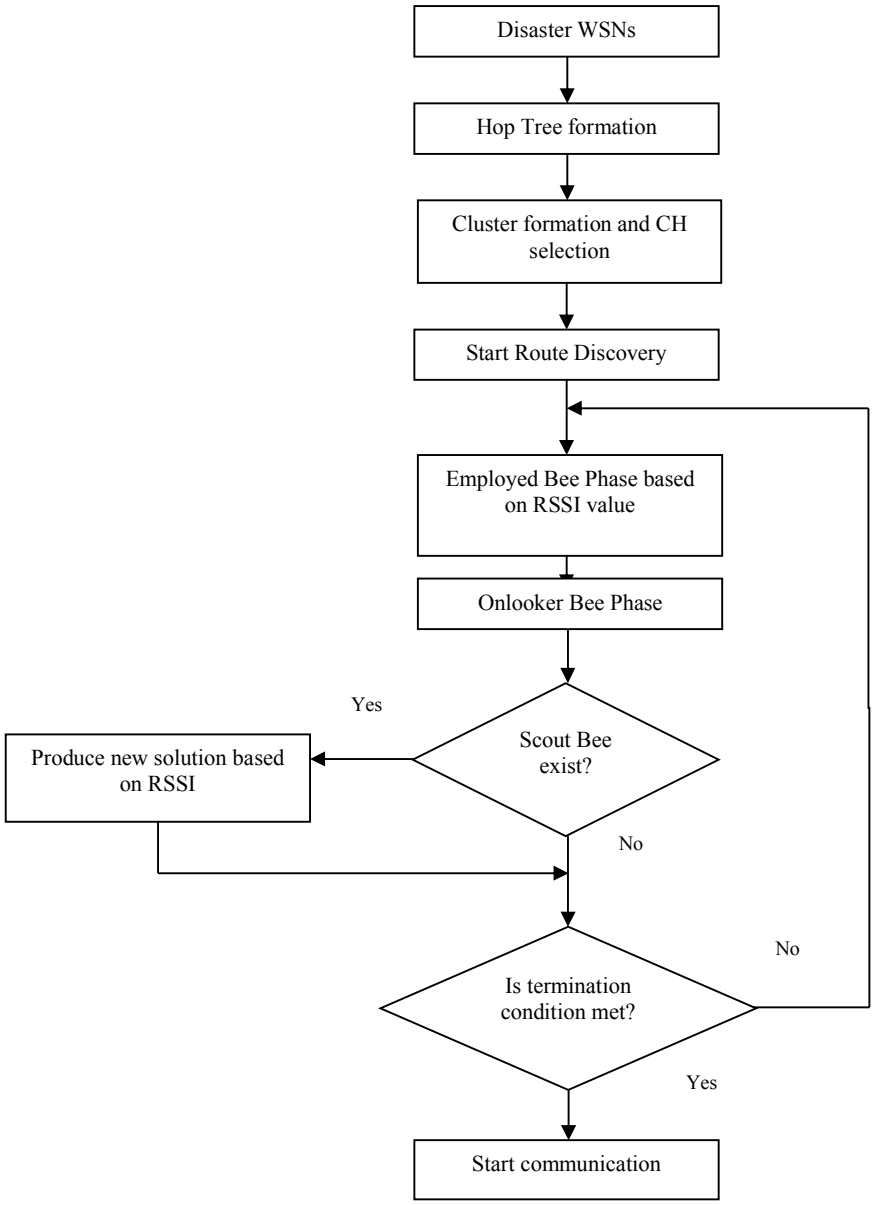


**Fig. 3: Flowchart of EBC-LABC**

## V. PRACTICAL ANALYSIS

This section presents practical analysis of network performance metrics such as throughput, packet delivery ratio, packets drop and consumed energy for variable nodes.

### A. Network Scenarios and Simulation Parameters

Network scenario and simulation parameters are shown in Table 1.

TABLE 1. SCENARIO AND SIMULATION PARAMETERS

| Network Parameters | Values |
|---|---|
| Routing Protocol / Algorithm | AODV, ABC, ABC-RSSI, EBC_LABC |
| Traffic Patterns | CBR (Constant Bit Rate) |
| Network Size | 1000 m × 1000 m (X x Y) |
| MAC Protocol | 802.11 |
| Number of Nodes | 10/30/60/100 |
| Initial Energy | 200J (for each node) |
| Node Speed | 3 m/s |
| Simulation Time | 30 s |
| Simulation Platform | NS-allinone-2.32 |

## B. Results and Analysis

*Results of Varying Number of Nodes*

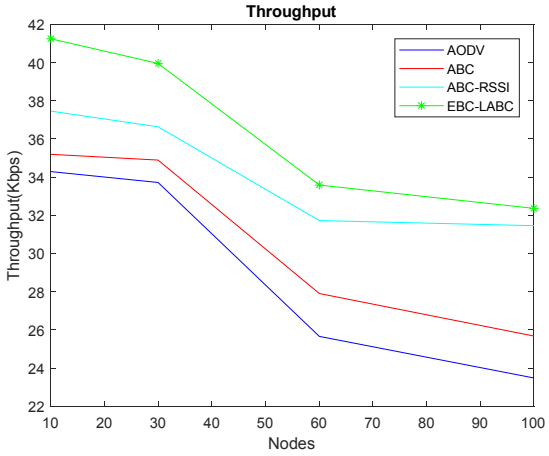


**Fig. 4: Throughput versus number of nodes**

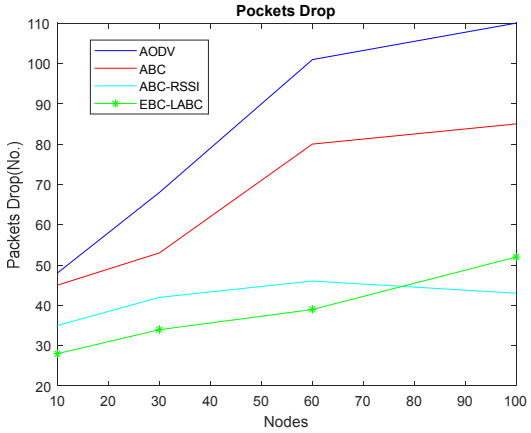


**Fig. 5: Packets drop versus number of nodes**

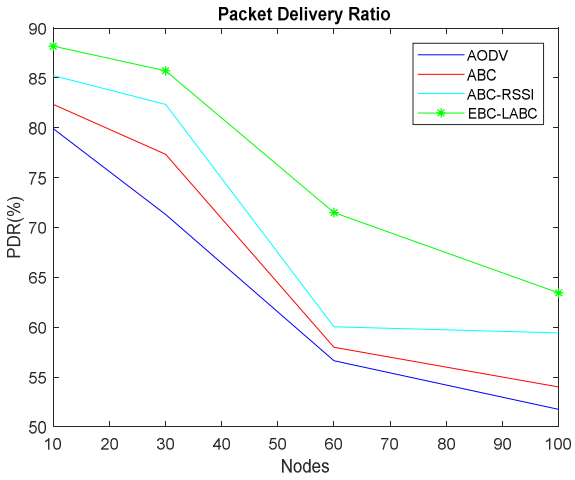


**Fig. 6: PDR versus number of nodes**

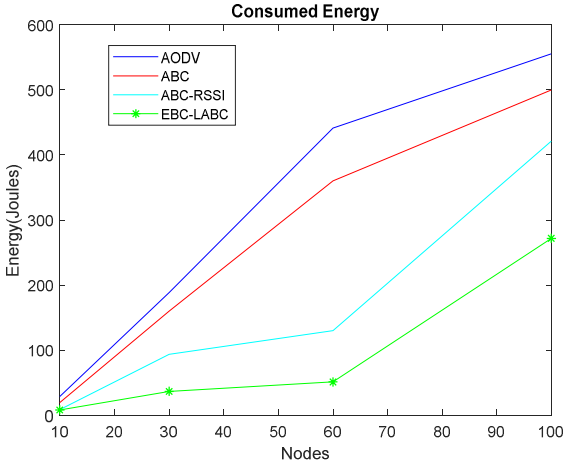


**Fig. 7: Energy versus number of nodes**

It is observed from Fig. 4 to Fig. 7 that the number of nodes increases with constant mobility; throughput, packet delivery ratio decreases and consumed energy, packets drop increases because:

- ✓ Probability of success in accessing the channel decreases,
- ✓ As hop count increases, congestion and delay increases.
- ✓ Collision and transmission error increases.

## VI. CONCLUSION

Proposed EBC-LABC routing algorithm is implemented and analyzed the performance of network by varying number of nodes. This algorithm is extensively compared to other algorithms like AODV, ABC and ABC-RSSI by considering network metric parameters such as throughput, packet delivery ratio, packets drop and consumed energy.

The simulation results show that EBC-LABC algorithm outperformed in comparison with other algorithms in disaster situation. Due to clustering technique and location information of nodes, proposed algorithm has achieved better performance. Clustering; data is aggregated

and sent to the sink (Base Station) through cluster head which reduces the overheads. Also location information of nodes is useful to send data to shortest distance node in less time.

Hence, an event based clustering localized artificial bee colony algorithm is useful for improvement in QoS, reduction in energy consumption of the WSN. It is most suitable for information monitoring in disaster situations.
The extension of the proposed algorithm will be considered for varying the node mobility and network areas as well as increasing nodes and mobility in the future work.

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