Energy Efficient Clustering and Path Selection of Mobile Sink in WSN

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Abstract— **Clustering is one of the energy-efficient solutions for the WSN in the static sink environment. The data is sensed by regular nodes and sent to the Cluster Head (CH). By deleting redundant packets, the CH collects and aggregates the data. Finally CH sends data to the sink node using single or multi-hop communication. The selection of CH depends on parameter like residual energy, distance form base station, density etc. In multi-hop network the sensed data from the remote nodes is transferred to sink through intermediate nodes. Thus the energy depletion is faster for nodes which are closer to the sink. This non uniform energy depletion reduces the network lifetime and disconnect sink node from other nodes. To overcome such condition Mobile Sink (MS) concept has been introduced. MS is used to collect data from nodes by traveling in the network and it is used to increase the network lifetime and delay constraint.**

***Keywords*— Mobile sink, WSN, Data gathering, Clustering, Routing and Multi Hop**

I. INTRODUCTION

In WSN employing mobile sink, data aggregation is one of the basic issue. One of the approaches is to find the shortest path for MS that visit the each node and collect the sensed data directly using single or multi-hop communication [1-3]. This will conserve the considerable amount of node energy, but it is impracticable as nodes and area increases. The other approach is to allow MS to visit inadequate number of positions called Rendezvous Point (RP) and collect data using multi-hop communication from non RPs of the network [4-5]. It is challenging to select most suitable RPs and path (route) length of MS which minimizes the energy consumption in multi-hop communication [6-8]. Here we proposed the method to find out the potential positions of RPs by modified k-Means algorithm. After selection of RPs, it is essential to eliminate the RPs which is not involved in transmission of data [9-12]. The MPSO algorithm is used for optimal path selection of MS for efficient data gathering [13-14]. Figure 1 represents general wireless network with components.

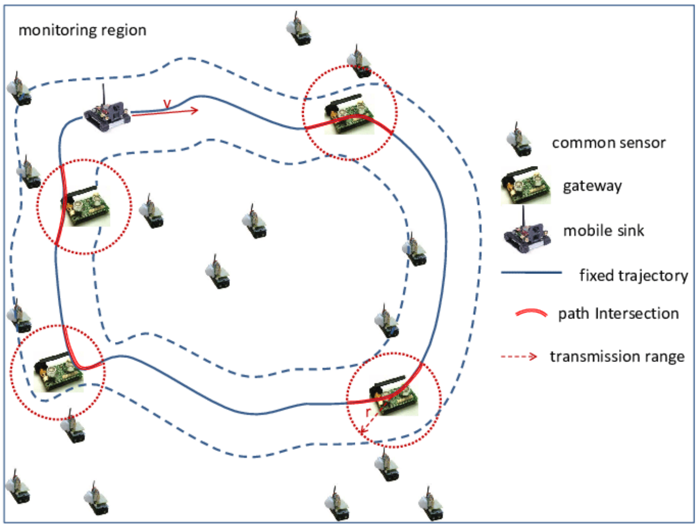

Fig. 1 Representation of Wireless network with components

The related work is described in Section II. The system model of proposed protocol is described in section III. Result and discussion is presented in section IV. Finally chapter ends with the conclusion in section V.

II. Related Work

In the static sink routing protocol, the data is forwarded towards the sink node using multi-hop techniques to save the power, but the node near to sink node acts as a relay node and it dies early [15-17]. This problem can be minimized by using MS, because MS reduces the energy utilization of nodes and increases the network lifetime. Many researchers have proposed the routing protocol using the mobile sink and it is classified into a hierarchical based and virtual structure based routing

Y.H. Wang et al [18] have proposed the mobile sink based clustering protocol. Each sensor node in the network exchanges their location and residual energy level with one another. This all information is saved in the neighbor information table. A CH is elected based on their residual energy among its neighbor's nodes. CH broadcast the advertisement to create a cluster. The nodes join the nearer CH to form the cluster. MS sends its location when it reaches to the new location. A CH collects aggregates and transmits data to the MS.

N. C. Wang et al [19] have proposed the data aggregation scheme in the hierarchical hybrid routing protocol. The sensor node is enabling with a Global Positioning System (GPS). Based on residual energy the gateway node is selected and it is responsible to collect, aggregate and transmits data to the mobile sink node. The gateway node is changed periodically as the sink node changes its location. This proposed protocol save the energy when the speed of sink is the maximum. Chu-Fu Wang et al [20] have proposed sink relocation algorithm which minimizes the energy consumption of a particular group of sensor nodes. This algorithm uses the residual energy parameter of nodes that adjust the transmission range and relocation of MS.

In [21], the author proposed an adaptive local update based routing protocol with MS. While sink moves its broadcast current location to the entire network that consumed more energy. Author proposed the protocol which mitigates the energy consumption problem by making the sink keep commutating with nodes by updating the local area. In addition, when sink moves away from the destination area through nodes which are far away from the sink still communicate without knowing the current location of the sink. This protocol is suitable for large scale and delays sensitive WSNs.

In [22] the author proposed a flexible probabilistic data distribution protocol, the storing node is selected on their weight based storage capacity and it is selected by central node. The sensor nodes sense the data and transmit to the storing node in the network and the MS is collecting the data from storing node. This protocol reduces the communication overheads but increased the end to end latency

In WSN, the large amount of data is same and it is an effective task to avoid the transmitting same data in the network. The data aggregation is a technique in WSN to aggregate all receiving packet into a one output packet and sent through the shortest path towards the sink node.

III. Proposed Method

We consider the homogeneous WSN consisting of N number of static sensor nodes that are randomly deployed in the area of interest. The sink node is mobile and traveling within the network with pre-assumed speed. The sink travels to selected nodes and collects the data along specified path.

Energy utilization is an essential concern for WSNs. The major cause of the energy utilization is taking place by the data collection. It is a progression which is used to combine the data from sensor nodes and conveying these data to the sink node or base station. Efficient data gathering mechanism helps to increase the effectiveness of the system. In existing data gathering schemes, nodes nearer to the sink receives information from all the other nodes and transmits it to the sink. Hence the nearby nodes of sink become overloaded and there is a chance for data loss as well as re-transmission may occur which leads to energy loss.

To overcome those issues our anticipated method is used. Here K-Means algorithm is used to select potential position of RPs from the collection of sensor nodes. After selection of RPs it is essential to eliminate the RPs which is not involved in transmission. Hence on the basis of weight value only the highest weight RPs are used for transmission and remaining RPs are set to sleep state to conserve the energy. After that, for efficient data gathering, optimal path selection of MS is performed using the particle swarm optimization algorithm. This algorithm provides the essential path for MS to collect the data. The data gathering is done, when MS reach to RP, it broadcast the ID with polling point message to respective RPs. All sensor nodes in the path directly distribute data to the respective RP, when MS passes through various RPs. In this way, the data is gathered with maximum efficiency from all RPs in the travel path of MS. The major benefit of the anticipated procedure is that every sensor node requires storing its own data using its own buffer.

Hence reduces overhead and energy consumption of sensor nodes due to the minimum distance between sensor node and sink. Thus efficient data gathering is accomplished by means of our estimated progression. The overall process of the proposed flow is shown in Figure 2.

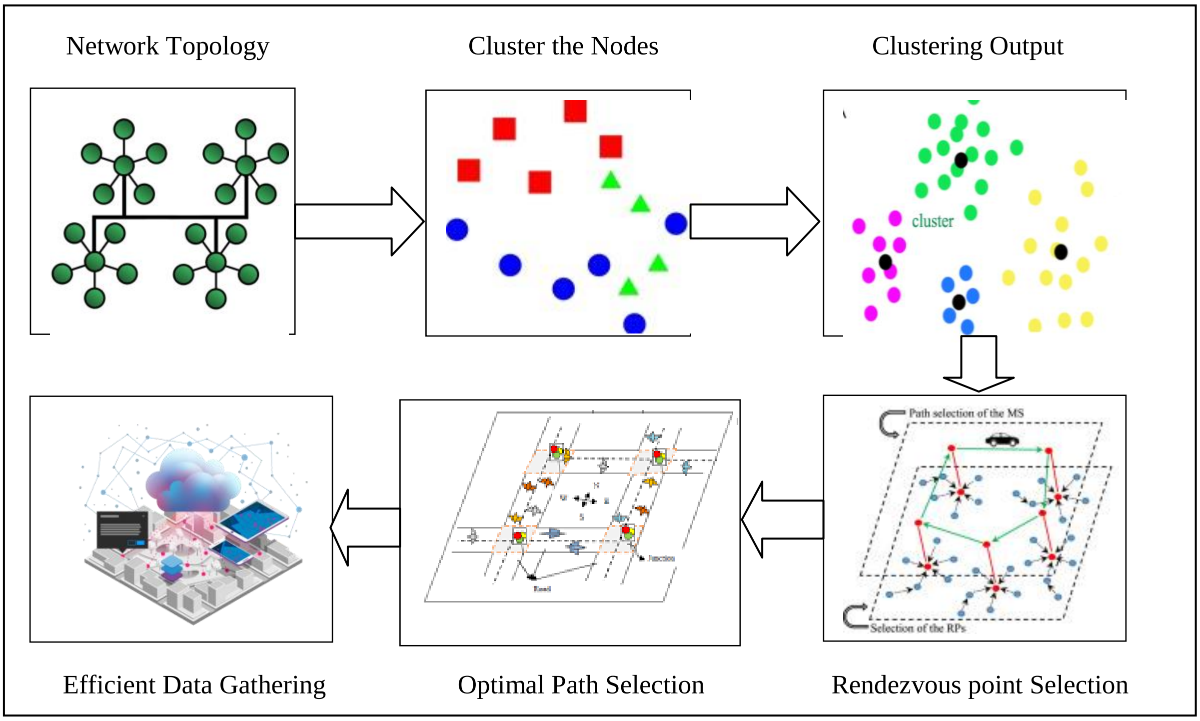

Fig. 2 Overall Process flow of the proposed approach

IV. RESULTS

This section illustrates the results and discussion of our anticipated energy efficient data aggregation in WSNs. The proposed method is implemented and simulated in Network Simulator 2 (NS2). The IEEE 802.11 protocol with the data rate of 500 Kbps is used in all simulations. To arrange the connection model by dissimilar random nodes the exponential traffic generator is used. Our reproduction settings and limitations are tabulated in Table 1.

Figure 3 illustrates the delay of our proposed work using Ad-hoc on demand Distance Vector (AODV) protocol. Though using the recommended technique the delay gets increases with respect to nodes. The anticipated process transmits the messages via RP to MS, with less delay in communication.

TABLE 1

SIMULATION PARAMETERS

No. of Nodes	**100 - 300**
Area	1000 m X 1000 m
MAC	MAC / 802 11
Simulation Time	100 sec
Traffic Source	CBR
Rate	500 Kbps
Propagation	Two Ray Ground
Antenna	Omni Antenna
Packet size	512byte
Channel Bandwidth	2.0e6 (Hz)
Channel Frequency(Hz)	Freq 2.4e9 (Hz)

Transmitter signal power (Watt)	Pt 0.28 (Watt)

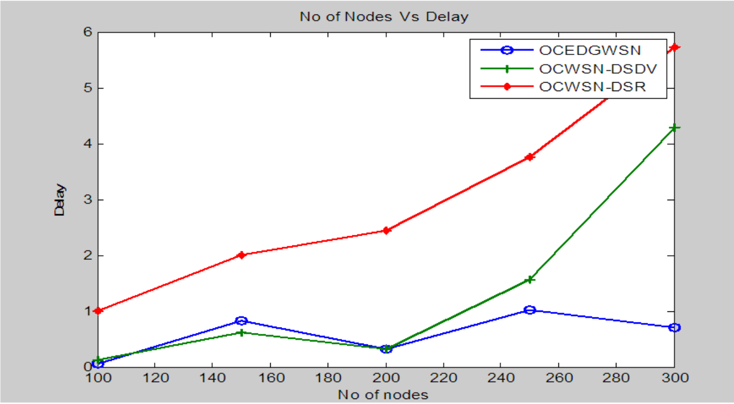

Fig. 3 Nodes Vs Delay (Sec)

Figure 4 represents the graphical representation of node verses delivery ratio of our proposed work. The delivery ratio of our projected work is higher than the delivery ratio of the traditional technique for different nodes.

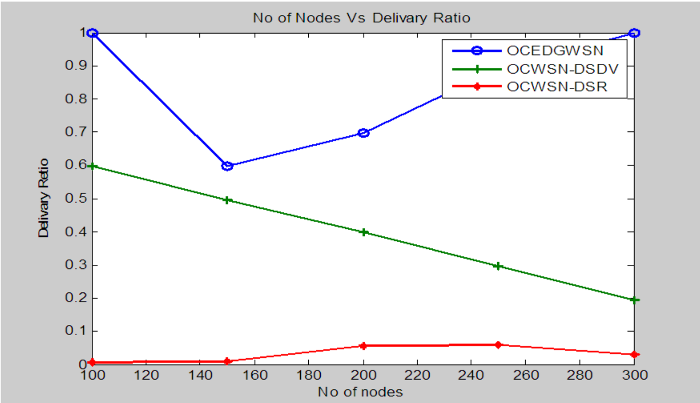

Fig 4. Node Vs Delivery Ratio (%)

Varying the number of nodes, the throughput value obtained using the proposed approach using AODV is greater than the throughput value obtained using the existing OCWSN, based on Dynamic Source Routing (DSR) and Destination Sequenced Distance Vector (DSDV). The graphical representation is shown in Figure 5.

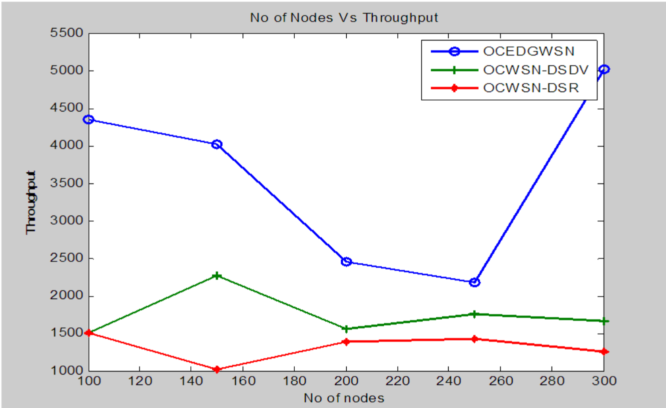

Fig. 5 Node Vs Throughput (Kbps)

V. Conclusion

We also suggested K means and Modified Particle Swarm Optimization for Mobile Sink route creation. By considering multiple parameters such as optimising the number of one hop neighbours, decreasing the average hop distance, and minimising the distance of RPs from the most suitable distance, both algorithms have been shown to choose an appropriate route for the MS. We have also suggested an effective mobile sink data collection framework to be used for every data collection round and reducing the packet size. The drawbacks of the proposed work are that we conclude that each node has the same data generation load and that MS halting period is insignificant. In the future, we will make an effort to develop the approaches that significantly reduce the mobile sink halting period and route of mobile sink.

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