Positioning of Mobile Sink in the Efficient and Best Position in the Wireless Sensor Network

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***Abstract*— Due to the movement of the sink breakage of inter nodes routes takes place, therefore the routing recovery is a critical challenge. The Immune Orthogonal Learning Particle Swarm Optimisation Algorithm (IOLPSOA) can improve the method with faster global convergence and higher route recovery due to the movement of the sink. In this project I propose a new mechanism where there will be multiple sink in a WSN and sinks are deployed with priorities. Sinks in the sensing field work based to the priority. At a particular time only one sink will be in motion which has highest priority at that time and it will find the global best position (GBP) and moves towards it. The sink will get the information about the GBP by collecting information about the nodes in the network. With the help of that information from the sensor nodes the sink will calculate the GBP and path to move there. When the sink will depletes to 20% of its energy then it will send request to the next highest priority sink which will be static. As soon as second sink receives the request from the depleted sink, it will start moving towards the depleted sink and takes its position gradually. This new sink will collect the required data from the nearby nodes until and unless the depleted sink dies. Immune Orthogonal Learning Particle Swarm Optimisation Algorithm (IOLPSOA) is used to maintain route from source node to sink which provide fast routing recovery and construct the efficient alternative path to repair the route. In this method network efficiency and network lifetime will increase.**

Index Words*— Global Best Positioning, IOLPSOA, mobile sink, routing recovery, wireless sensor networks.

I. INTRODUCTION

Wireless Sensor Networks (WSNs) have plays important role of the Internet of Things (IoT) are used in many benefits around the world, such as volcano and fire monitoring, urban sensing, to find out rare animal and perimeter surveillance. In the WSNs, a sink is defined as an entity that collects data from the sensors in the sensing field. With the development of 3G phones, mobile PDAs and other handheld devices, more and more applications need to integrate sink node. With the help of these devices, mobile sink is needed to fulfill the requirement. A mobile sink can potentially continue the network's lifetime by using lower energy of the sensor nodes close to sink due to its changing positions. Internet is extending its reach to the real world through innovations collectively termed the Internet of Things. The IoT connects a variety of access devices with the mobile network and Internet, and uses the analysed sensor data to provide users with many specific services, such as remote medical care and intelligent transportation system. Wireless sensor networks (WSNs) have played an important role of IoT due to the inability of collecting data from the environment and reporting them back to a sink. In the WSNs, a sink is defined as a user that collects the data reported from the network, such as PDAs and robots equipped with wireless devices. With the development of 3G phones, mobile PDAs and the handheld devices, more and more applications need to integrate sink node with these devices, thus mobility of sink is required. In these applications, most of the nodes stay static while sinks are mobile. It has been demonstrated that a mobile sink can potentially increase the network's lifetime by causing lower consuming energy of the sensor nodes close to the sink due to its changing positions.

Mobile sink can gradually continue the network's lifetime by using lower energy of the sensor nodes close to sink due to its changing positions. In Mobile sink whenever a path from the source node to mobile sink is broken due to the sink mobility, routing recovery messages would be exchanged to form an alternative path. In order to build an alternative path from the source node to the sink information provided by the previous path is used. This method increases the communication overhead and thus reduces the network performance in terms of delay and energy consumption.

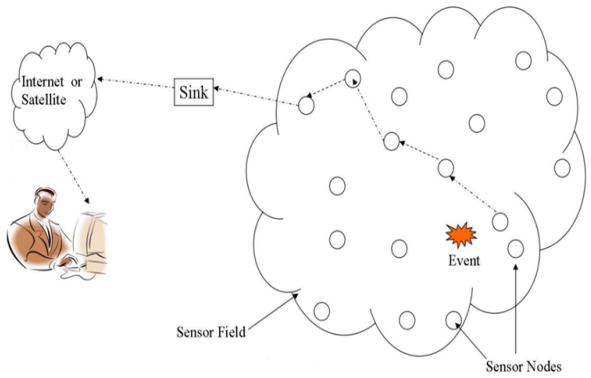


Fig. 1. Representation of wireless sensor network

A Particle Swarm Based routing recovery method is to address the problem of data delivery from the sources to the mobile sink. PSOA adjusts its flying path according to its personal best experience and global best experience. Offer a faster global convergence and higher solution quality and improves network performance .As we know, Particle Swarm

Optimization Algorithm (PSOA) searches for an optimum solution through each particle flying in the search space and flying trajectory is adjusted according to its personal best and global best experience [2]. Owing to its simple algorithm structure and high efficiency, PSOA has become a widely adopted optimization technique.

Particle Swarm Optimisation Algorithm (PSOA) was improved by using the cooperative behavior of multiple swarms and Cooperative Particle Swarm Optimisation Algorithm (CPSOA) was made. In CPSOA limitation of a particle is compensated by all other particles. Then Orthogonal Learning Particle Swarm Optimisation Algorithm (OLPSOA) was developed to guide the particle to fly towards the global optimum more steadily. OLPSOA got revised to IOLPSOA by adding the immune mechanism [7]. This will provide more diversity to the algorithm. I am using Immune Orthogonal Learning Particle Swarm Optimisation Algorithm for routing recovery. It provides efficient route repair for topology changed by the sink movement, communication overhead is reduced and WSNs lifetime is increased.

II. EXISTING SYSTEMS

IOLPSOA algorithm is used to address the routing problem of data transmission from sources to the mobile sink. IOLPSOA uses basics of Particle Swarm Optimization Algorithm. In PSOA search for an optimal solution through each particle flying in the search space and adjusting its flying trajectory according to its personal best experience and global best experience is done. Owing to its simple structure and high efficiency, the PSOA has become widely adopted optimization technique.

The particle may suffer the phenomenon that some dimensions of the solution vector may be improved by one exemplar or deteriorated by the other exemplar, and lead to undesired local optimum [2]. Hence, how to discover more useful information to construct a promising and efficient exemplar to guide the particle flying steadily towards the global optimal region is a challenging issue.

In this system nodes will be static and sink will be mobile. Due to sink mobility route from sink to source node will break. Routing recovery should be done. For routing recovery first sink will send get node request to all nodes in the network. After collecting information from the nodes sink will use Immune Orthogonal Learning Particle Swarm Optimisation Algorithm for routing recovery. In this algorithm firstly position and velocity of nodes are updated time to time which will help for the sink movement [1]. Sink will select the nodes which are appropriate for the route formation. After selecting the nodes sink will perform the immunization step to find immunity of nodes in route formation.

In immunization step of IOLPSOA each particle can be considered as an antibody, it produces offspring by cloning, increases diversity in the search process by mutation, eliminates the inappropriate particle by immune suppression and stores the appropriate solution through immune memory. Only immune nodes are considered for route formation and other nodes are terminated. In the IOLPSOA, flying direction of the particle (antibody) is optimised by the OL strategy and its diversity is increased mostly by immune mechanism.

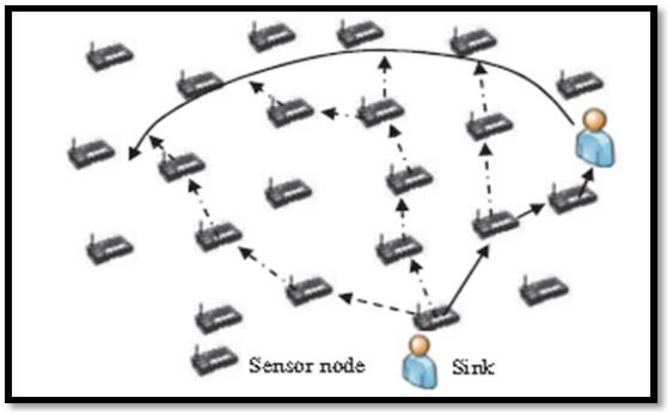


Fig. 2. Routing recovery for mWSNs with a mobile sink

A. *Advantages*

• Routing recovery from path failure is fast.
• Offers faster global convergence and higher solution quality.
• Routing protocol in mobile sink is improved by using IOLPSOA.

B. *Disadvantages*

• Here the frequent information updates and communication overheads would consume excessive battery energy of the nodes, and shorten the network lifetime.
• The AODV and other conventional protocols always provide global network path recovery with high communication overheads.
• The existing mechanism reduces the network performance in terms of delay.

III. PROPOSED SYSTEM

In proposed system based on the number of the nodes multiple sinks are deployed. Priorities will be assigned to all the sinks and based on the priority sink will work. First priority sink will moving and other sinks will be static in particular position. Sink 1 which is mobile will send the get node packet which contains the sink id to the nodes in 1 hop distance to collect information of those nodes. After getting the get node request nodes will send information like position, energy level, data type and task table of that node to the sink. Nodes which has got get node request will pass the request to its neighbor nodes. And collect neighbor node information and pass it to the sink.

Once collecting information from all the required nodes sink will calculate the global best position (GBP). Global best position is the position where the transmission rate is higher and energy consumption is less. For the calculation of the global best position sink will collect information from the nodes that is blank places in the network. After getting this information sink will calculate particular blank position where maximum transmission rate, low energy consumption and having shortest path from maximum nodes.

Sink will calculate the path to move towards global best position. Sink will then establish the route with the nodes for data transmission. For this routing immune orthogonal learning particle swarm optimisation algorithm is used. In this algorithm node updating, immunization and termination steps are there. In updating step nodes for route formation are chosen. Immunization step will check immunity of nodes like remaining energy and immune nodes are selected. Other nodes are terminated which are not immune. IOLPSOA based routing recovery protocol provide fast routing recovery from path failure, which can support the sink mobility of conventional routing protocols.

Once first priority sink's energy depletes and only around 20% of energy is remaining it will send a request and its position to the second priority sink which is static replace it. Once sink 2 receives this request its start moving towards sink 1 position. Sink 2 will go near to the sink 1 and waits till sink 1 energy completely depleted. Once energy depleted sink 2 will replace sink 1 and sink 2 will collect all the information from the sink1.

Global best position will be changing based on the time and remaining energy in the nodes. So sink will be collecting the information from the nodes in particular time and by keeping track of this information GBP will be updated. By this method energy consumption can be reduced and network lifetime is increased.

A. Advantages

- The Computation Complexity over only one sink is reduced.
- Introduction of multiple sinks results in fast transmission.
- When the energy of one sink depletes it is being replaced by the new sink which helps in continuous transmission of data without any loss.

IV. SYSTEM DESIGN

First process is deployment of nodes which are static. Based on the number of nodes multiple mobile sinks are deployed. Priority will be assigned to the sinks. Sink will collect all the required information from the nodes and will be used for route recovery. Communication between sink and node will be done and all nodes information will be collected by sink for GBP calculation. Communication between sink and node is done by sending GN packet and receiving GNR packet [4].

Global Best Position is calculated. GBP position is the position where transmission rate will be high and energy consumption is less. While determining GBP also sink will be collecting information from the nodes and for this routing is required. For routing purpose IOLPSO algorithm is used which provides the efficient routing recovery. As there will be a sink movement breakage of route will be there and IOLPSO algorithm is used for routing recovery. Then sink will track the route to the GBP and it goes to that particular position. Once sink is in GBP routing is done again to the source node and data is collected. Sink will be moving in the defined path, when sink's energy depletes it sends request to the second sink to replace it and second sink will collect required information from first sink and replaces it. Like this the network energy will be saved.

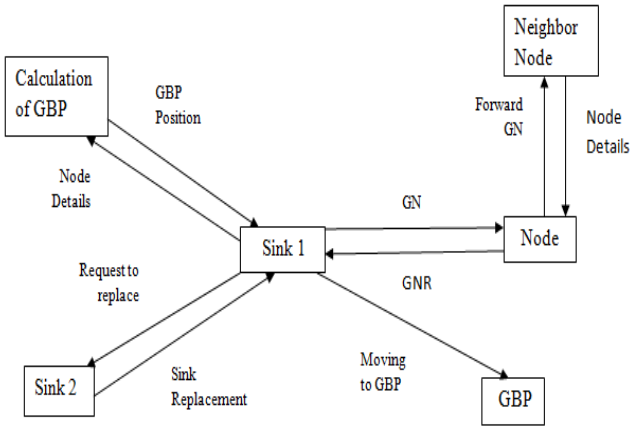


Fig. 3. Architecture Diagram

A. Network Deployment

First in the node deployment process, the requested node has to send a request to the main node with the help of the socket programming. The Server Socket Part of the main node shall receive the request which is sent from the requested node then it updates the IP and port that has been assign to that requested user. The new port which is for the respected node is sent back to the node and the node runs a server socket with the new port and thus the node gets deployed.

In the Sink mechanism the sink sends its own ip address and port number and then that information is sent to the main node. A listening thread for the sink is running on the background in order to receive the request sent from the sink. So the listening thread receives the ip and port sent from the sink and then it increases the port and after that the updated port number is sent back to the sink. The sink after receiving

the port number starts a new thread that listens on the new port number sent from the Main node.

B. Node Sink Communication

Sink will collect information from the nodes by sending GN to the nodes in 1 hop distance. Those nodes will forward GN to its neighbouring nodes and collects information from them like task table, id, and energy information. Node will send GNR back to the sink containing information about itself and its neighboring nodes [1]. Based on this information sink will calculate GBP and path towards GBP.

Algorithm 1: Collecting node information.

Step 1: When the moving sink is disconnected it sends the GN packet containing the task table. The node received the GN increases from m to m+1 and relays the packet to its neighbours.
Step 2: If a node received GN is a node on the previous path, it responds the GNR containing its neighbour table and task table.
Step 3: The sink collects all the information of the nodes which have transmitted GNR, and updates its neighbour table. Then, the sink calculates and constructs the optimal alternative path.
Step 4: The sink broadcasts the packet GNR_ACK containing current information. Whenever a node receives it, it checks whether its ID is in the task table. Then it establishes the connection with sink.

C. GBP Determination

Sink will calculate the global best position with all the collected information where the performance of the network is at its best. Sink will store all the information from the nodes in a table. Firstly sink will find the nodes which have the maximum number of neighbor nodes.
It will get such nodes and find out the transmission of those nodes and finds the intersection of maximum transmission range. If that intersecting points are more than one then it will check which point is nearer to the sink and which has low energy consumption and it will fetch it as a Global Best Position.

Algorithm 2: Calculation of GBP

Step 1: Sink stores information from all the nodes and stores it in the table.
Step 2: Sink selects the node which have the maximum number of neighbor nodes.
Step 3: Then sink will calculate the intersecting point of transmission range.
Step 4: If more than one intersecting points are there then sink will check the point which is nearest and less energy consuming
Step 5: By taking all these criteria the GBP is calculated and sink will get the global best position.

D. IOLPSO Algorithm

This algorithm is used for the routing recovery. Because of the movement of the sink route will break and routing recovery is most important thing. With the help of IOLPSOA routing is done fast and efficiently [6].

Algorithm 3: Routing Recovery

Step 1: In this step node updating is done. Sink will see which are possible nodes can be involved in the routing.
Step 2: Nodes which are selected for routing are checked for their immunization [5].
Step 3: Which nodes are immune enough are selected and other nodes are terminated.
Step 4: By selected nodes route is formed.

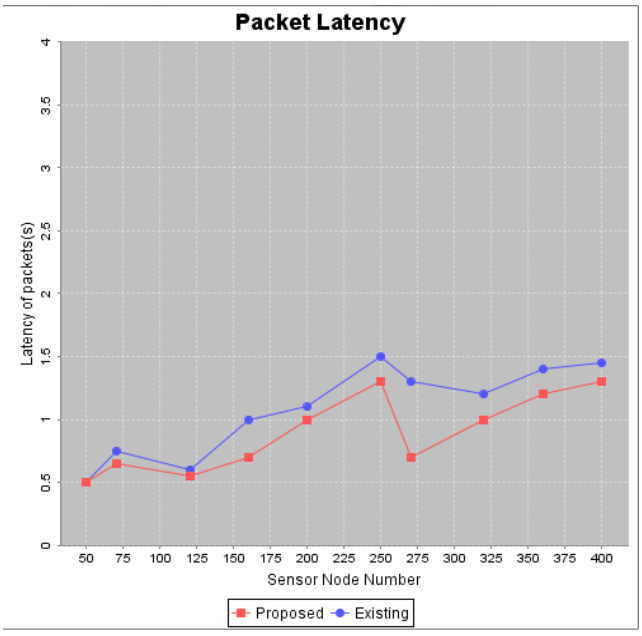
E. Tracking To GBP

In this step sink after getting the GBP will track the path towards that position. And move in such a way that it reaches the GBP efficiently.

F. Sink Replacement

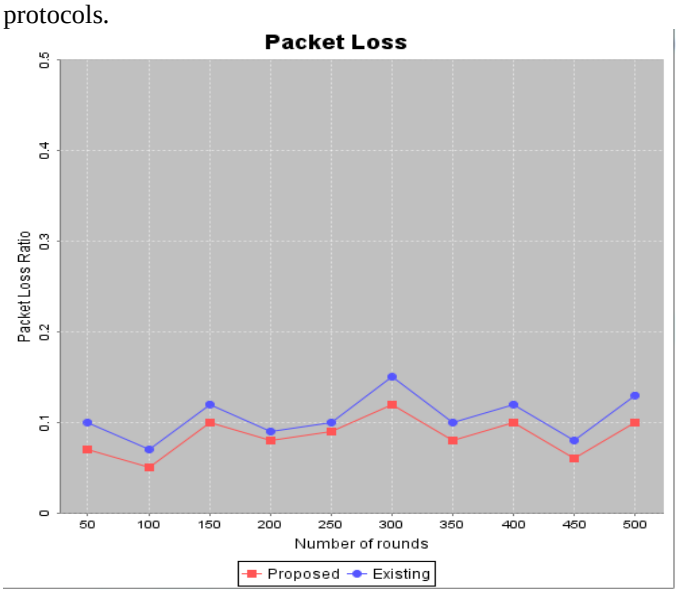
The sink will be moving in the defined path, when sink's energy depletes it sends request to the second sink to replace it and second sink will collect required information from first sink and replaces it. Like this the network energy will be saved.

V. RESULTS



The latency of packet delivery from source to the sink is given in above graph. X-axis represents the number of sensor nodes in the network and y-axis is the average data packet delivery latency. Because of the addition of time complexity of the proposed mechanism, the average latency of packet delivery of the IOLPSOA is less as compared. But as the network scale grows, new mechanism has demonstrated a

lower latency trend of packets delivery than the other protocols.



The proposed mechanism provides a fast routing recovery from path failure. Whenever the path is broken due to the sink movement recovery should be done as fast as possible. Delay in the routing recovery means more packet loss. New mechanism provides a fast routing recovery and packet loss is reduced efficiently.

VI. CONCLUSIONS

In this paper by calculating the GBP and moving sink to the GBP energy consumption of the network is reduced and lifetime is increased. GBP of the sink will be changing and in particular interval it is calculated again. IOLPSO algorithm also gives an energy efficient routing recovery. Sink movement improves the efficiency by replacing the depleted sink and thus network lifetime is increased. So by this all overall network lifetime and network efficiency is increased.

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