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A Hole Dynamic Interference Avoidance Scheme with Inter Boundary Coordination in Wireless Sensor Networks

M. K. Pavithra[1]
M.Phil-Full Time Research Scholar,
Department of Computer Science & Applications,
Vivekanandha College of Arts and Sciences for Women (Autonomous),Elayampalayam, Tiruchengode,
TamilNadu, India.

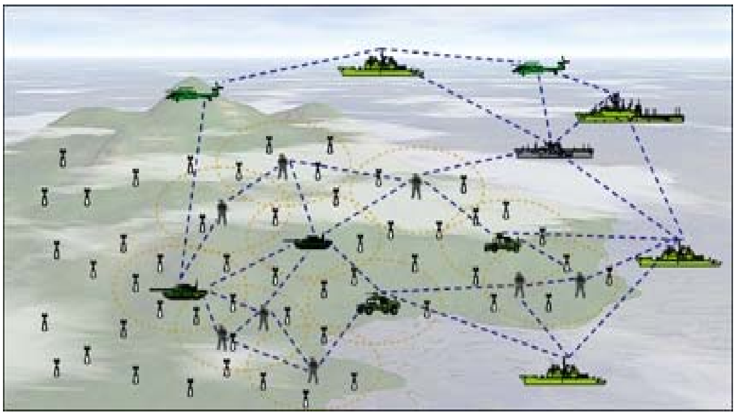
M. Jothilakshmi[2]
Asst. Professor,
Department of Computer Science & Applications,
Vivekanandha College of Arts and Sciences for Women (Autonomous),Elayampalayam, Tiruchengode,
TamilNadu, India.

***Abstract:** A wireless sensor network can get separated into multiple connected components due to the failure of some of its nodes, which is called a "hole." The unreachability problem (i.e., the so-called hole problem) that exists in the existing routing algorithms has been studied for the wireless sensor networks. Hole Dynamic Interference Avoidance (HDIA) protocol is proposed to solve the hole problem with increased routing efficiency by exploiting the boundary finding technique for the Hole Detection and Healing (HEAL). The proposed boundary traversal is employed to completely guarantee the delivery of packets from the source to the destination node under the network. The boundary map (BM) is proposed as efficient algorithms for the realization of the HDIA. In order to maintain the network requirement of the proposed HDIA scheme for a portion of nodes that facilitate boundary traversal. These schemes are incorporated within the HDIA protocol to further enhance the routing performance with reduced communication overhead. The proofs of correctness for the HDIA scheme are also given in this project. Comparing with the existing routing algorithms, the simulation results show that the proposed HDIA-based protocols can provide better routing efficiency. The proposed algorithm is based through simulations which as GLOMOSIM simulator.*

***Keywords:** Hole Dynamic Interference Avoidance (HDIA), Hole Detection and Healing (HEAL), Boundary map, GLOMOSIM, Hole Detection in WSN, Hole Recovery in WSN, Hole Healing Area(HHA),Hole Manager(HM)in WSN.*

I. INTRODUCTION

Wireless Sensor Network (WSN) is a collection of spatially deployed wireless sensors by which to monitor various changes of environmental conditions (e.g., forest fire, air pollutant concentration, and object moving) in a collaborative manner without relying on any underlying infrastructure .Due to a wide diversity of WSN application requirements, a general-purpose WSN design cannot fulfill the needs of all applications. Many network parameters such as sensing range, transmission range, and node density have to be carefully considered at the network design stage, according to specific applications. Wireless sensor networks are deployed to monitor the sensing field and gather information from it. Traditionally, two approaches can be adopted to accomplish the data collection task: through direct communication, and through multi-hop forwarding. In the first case, sensor nodes upload data directly to the sink through one-hop wireless communication, which may result in long communication distances and degrade the energy efficiency of sensor nodes. On the other hand, with multi-hop forwarding, data are reported to the sink through multiple relays, and the communication distance is reduced.



One of the main design goals of WSNs is to carry out data communication while trying to prolong the lifetime of the network and prevent connectivity degradation by employing aggressive energy management techniques. The design of routing protocols in WSNs is influenced by many challenging factors. These factors must be overcome before efficient communication can be achieved in WSNs. . However, in random node deployment, the sensor nodes are scattered randomly creating an infrastructure in an ad hoc manner. If the resultant distribution of nodes is not uniform, optimal clustering becomes necessary to allow connectivity and enable energy efficient network operation. Inter-sensor communication is normally within short transmission ranges due to energy and bandwidth limitations. Therefore, it is most likely that a route will consist of multiple wireless hops.

II. Proposed Work

Holes detection and healing (HEAL) that has a very low complexity and avoid some drawbacks noticed in previous works. HEAL is a distributed and localized algorithm that operates in two distinct phases. The first phase consists of three subtasks; hole identification, hole discovery (HD) and border detection,hole detection algorithm (DHD) that operates over the Gabriel graph (GG) of the network. DHD has a very low complexity and deals with holes of various forms and sizes despite the nodes distribution and density.The second phase treats the hole healing with novel concept, hole healing area (HHA). It consists of two sub-tasks; hole healing area determination and node relocation. We propose a distributed virtual forces-based local healing approach based on the hole healing area, in which the forces will be effective. This allows a local healing where only the nodes located at an appropriate distance from the hole will be involved in the healing process.

HOLES DETECTION AND HEALING (HEAL)

In our HEAL, the existence of hole in the RoI is determined and its boundary is computed. Later which the Hole Healing Algorithm (HHA) is followed; simple healing process is invoked such that only selective nodes located within the certain range will be involved in hole healing. Such selected mobile nodes are mutually attracted towards the hole center maintaining a fixed distance to achieve a minimum overlapping distance between them to avoid congestion. In the boundary detection algorithm, we discover the existence of improperly covered RoI boundaries. The node where a packet may get stuck is called a local minimum or stuck node. But on the other hand, if there is no sink or destination available for the deployed nodes then the possibility of identifying a stuck node becomes impossible.

To overcome this issue, through HEAL, each node is capable of identifying itself whether it is a stuck node or not, irrespective of the presence of a sink or storage data center.

In our algorithm TENT Rule,

» We ensure that each individual node is capable of communicating in 360o with respect to its communication range.

» The TENT rule specifies that a node is not a stuck node if where there exists at least one 1-hop neighbor within the range of angle spanned by itself which is less than π/4.

- » The process of discovering a hole is first initiated by the identification of stuck nodes.
- » Each node executes the TENT rule to check whether the node itself is a stuck node or not.

HOLE DETECTION

All the nodes that are marked as stuck nodes by the TENT rule will check its location information against the available boundary range of RoI. As the result they differentiate themselves from the boundary nodes of the RoI and proceed with the process of determining hole boundary. Once a node identifies itself as a stuck node it generates a new Hole Discovery (HD) packet, marked with its ID and forwards it to the next boundary node where node is chosen based on Stuck TENT Rule. If node is a stuck node then inserts its location information into the received HD packet and forwards it to the node in the same way creating a cascading effect. This process is repeated until the HD packet has traveled around the hole and eventually been received by the initiator node. Finally, the node that has the smallest Node-ID removes the HD packet and names itself as Hole Manager (HM). It will be responsible for the hole-healing announcement. This is in contrast to the Hole Manager Selection strategy where one can pick the node with the largest residual energy among all the boundary nodes.

HOLE HEALING

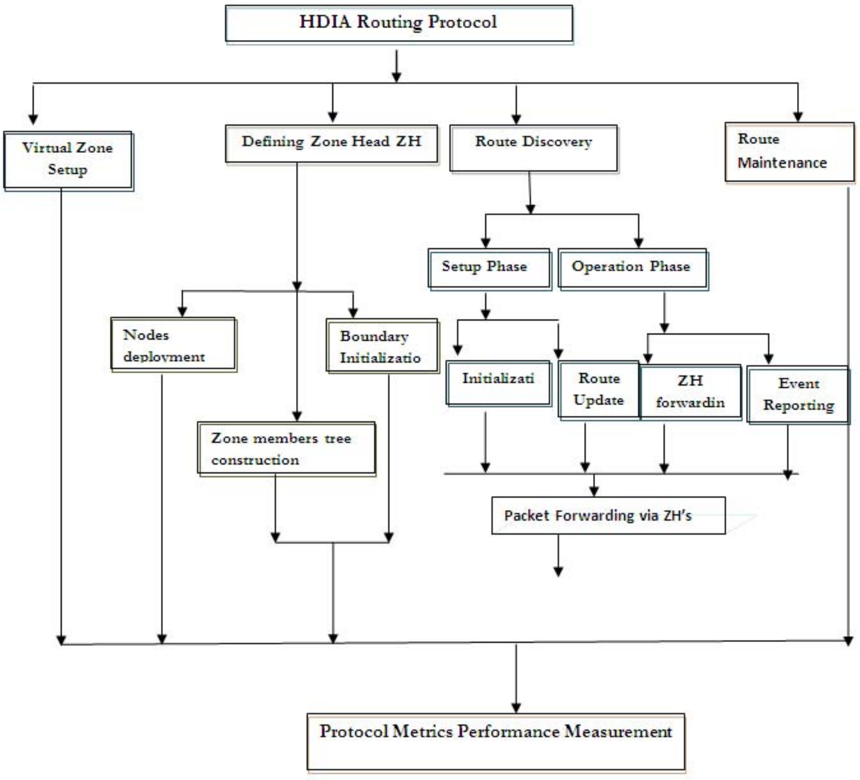
At the end of the hole detection phase, the healing phase is executed. In this phase, the HM node plays the role of determining the hole dimension and informing nodes on their movement. The HM node has information about the size of the hole and boundary nodes. The HM node calculates the number of nodes present in the HHA-0. It solicits its direct neighbors to calculate the number of their neighbors in this area. It sends a Hole Healing Area Determination packet containing information about the hole. This communication is done over to reduce the number of exchanged messages. If the number of nodes found by the HM node is less than the required number to heal the hole, the movement of these nodes will create new holes. To avoid this scenario the HM node starts a new round by increasing value, and then it repeats this process until it finds a sufficient number of nodes to recover the hole.

HOLE DYNAMIC INTERFERENCE AVOIDANCE PROTOCOL

- » **HDIA** uses a virtual-zone-based structure to implement scalable and efficient group membership management.
- » A network wide zone-based bidirectional tree is constructed to achieve more efficient membership management and multi hop delivery.
- » The position information is used to guide the zone structure building, multi hop tree construction, and multi hop packet forwarding, which efficiently reduces the overhead for route searching and tree structure maintenance. .
- » Group members, by combining the location service with the membership management to avoid the need and overhead of using a separate location server
- » An important concept zone depth, which is efficient in guiding the tree branch building and tree structure maintenance, especially in the presence of node mobility.
- » Nodes self-organizing into zones, zone-based bidirectional-tree-based distribution paths can be built quickly for efficient multi hop packet forwarding.

III. ARCHITECTURE DIAGRAM

This paper proposes the IND-OCPA-P model to analyze the security of the proposed EOB and the encryption schemes supporting an efficient range query over encrypted data.



IV. ALORITHM

FOR HOLE

To find the appropriate radius, we have used an iterative approach based on the following formula:

R * r =(1+ þ) ; b 2 Rþ where r is the hole radius. b is a positive constant, which depends on the nodes density and the sensing range Rs. For b ¼ 0, we start with a radius equals to the estimated hole radius r

$$\vec{F}_a(p,v) = \begin{cases} \frac{-k_a}{d(p,v)l_a} * e^{\frac{r}{d(p,v)}} \overrightarrow{u_a}, & d(p,v) > d^a_{th} \\ 0, & d(p,v) \leq d^a_{th} \end{cases} \quad (1)$$

$$\vec{F}_r(p,q) = \begin{cases} \frac{k_r}{d(p,q)l_r} \overrightarrow{u_r}, & 0 < d(p,q) < d^r_{th} \\ 0, & d(p,q) \geq d^r_{th} \end{cases} \quad (2)$$

Note that the magnitude and orientation of F ~p can be easily calculated, for example, Robomote [14] uses an on-board compass combined with localization information for navigation purposes. If F ~p ¼ 0 then the node p remains in its original position. Otherwise, p moves one time step in the direction imposed by F ~p. The final position of p is given by:

$$\vec{P}_p(t+\Delta t) = \frac{\vec{F}_p}{||\vec{F}_p||} * V + \vec{P}_p(t) \quad (3)$$

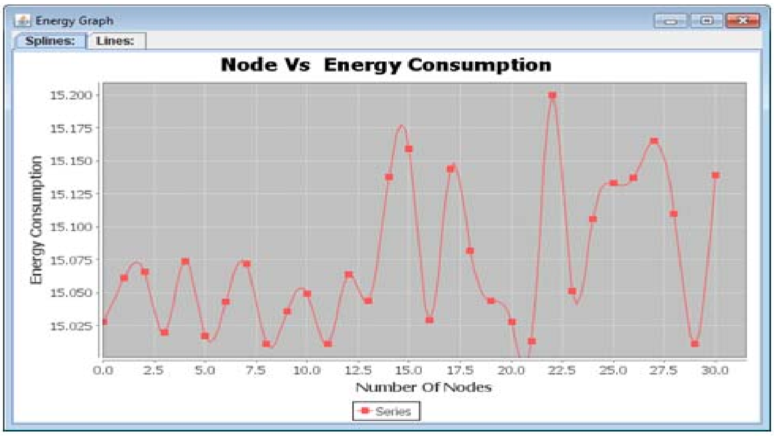
where V is the node velocity and P ~pðtÞ is its position at instant t.

V. EXPERIMENTAL RESULTS

ENERGY CONSUMPTION

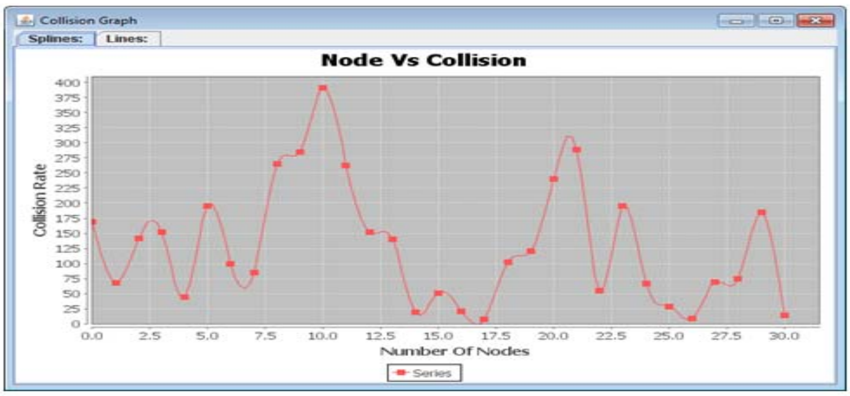
The performance of energy consumption is a measure of energy spent for forwarding a packet to the destination via neighbor nodes and duty cycled based sleep scheduling. HEAL devour more energy and each time it sends signal to all the available nodes in the path to the destination to send the data packets and consumes more energy when recover from sleep state. HEAL could not cope up with the large group size and network size. This problem is overcomes in the proposed research work HDIA.The glomosim code was modified to obtain the amount of energy consumed over time under clustering optimized technique. In this way, accurate information was obtained about energy at every simulation time. The used these data to evaluate the protocols from the energetic point of view.

Average energy consumption: this parameter allows making considerations about energy wastage associated with the route maintenance and route discovery and it accounts for energy consumption during transmission and reception of control and data packets. The energy consumption is calculated by the cost of transmitting packet, receiving of packets and discarding of the packets during the period of link error. The energy consumption of existing protocol is average of 59mWhr and its highly reduced.



COLLISION RATE

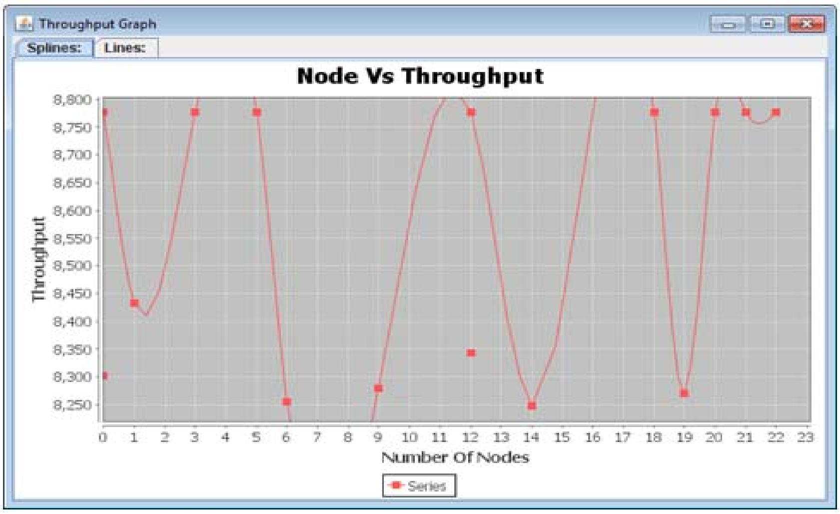
In a network, when two or more stations attempt to transmit a packet across the network at the same time, a packet collision occurs. When a packet collision occurs, the packets are either discarded or sent back to their originating stations and then retransmitted in a timed sequence to avoid further collision. Packet collisions can result in the loss of packet integrity or can impede the performance of a network. In the proposed routing protocol HDIA the collision rate is highly reduced when compared to the existing protocol layer. The collision rate is calculated by dividing the number of packet collisions detected by the number of packets transmitted. The collision rate factor of HDIA is extremely very low when compared with the HEAL.



THROUGHPUT

The amount of data transferred from one place to another or processed in a specified amount of time. Data transfer rates for networks are measured in terms of throughput. The Throughput measures the number of packets received per second at the mobile sink node.

In the proposed routing protocol HDIA the throughput rate is highly increased when compared to the existing protocol HEAL. Network throughput performance refers to the average data rate of successful data or message delivery over a specific communications link. Network throughput is measured in bits per second (bps). The throughput factor of HDIA is extremely very high when compared with the HEAL.



Performance Metrics	HEAL	HOLE
Energy Utilization	High	Reduced
Collision Rate	High	Reduced
Throughput	Low	Improved

VI. Conclusion And Future Enhancement

This project has implemented a lightweight and comprehensive two-phase protocol, HDIA, for ensuring area coverage employing a mobile WSN. Compared to the voronoi with boundary edge has a very low complexity and deals with holes of various forms and sizes despite the nodes distribution and density. By exploiting the virtual boundary with edge mark concept, our approach relocates only the adequate nodes within the shortest time and at the lowest cost. Through the performance evaluation, we validated HDIA, using different criteria and showed that it heals the holes by placement despite their number or size with less mobility in various situations. The evaluation results demonstrate that HDIA provides a cost-effective and an accurate solution for hole avoiding placement in mobile WSNs.

The impact of different partitioning strategies (of the target field), such as area shapes, on the performance and security are involved. polynomial shares and seek the optimal solution Optimizing public-key protocols for sensor networks is investigate the interaction between HDIA and the network layer for on-demand trust level routing.

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