Optimized Greedy Perimeter Stateless Routing

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Abstract- Greedy Perimeter Stateless Routing (GPSR), a most preferable routing protocol for wireless sensor networks (WSN) which uses the positions of nodes for packet's destination to make packet forwarding decisions efficiently. It offers immediate routing support for WSN. Because of asymmetric nature of WSN, symmetric links with bidirectional dataflow is not sufficient when the destination is outside the boundary of GPSR. When the route becomes outside the boundary then it affects the energy efficiency of GPSR. So in this paper optimized approach as genetic algorithm is introduced into the GPSR to identify optimal route based on energy utilization and overcome problems in GPSR so that energy efficiency of using GPSR in asymmetric WSN can be increased. The simulation result proves that the factor including delay and energy is minimized and hence the proposed protocol outperforms the existing routing protocol for WSN.

Keywords – ***Wireless sensor networks, GPSR, Routing protocol***

I. INTRODUCTION

A Wireless Sensor Network (WSN) is a network composition of individual nodes that are spatially distributed among the field using sensors to cooperatively monitor parameters under physical or environmental conditions at numerous locations as shown in Fig.1. These nodes have to contribute in order to fulfill their assigned tasks and wireless communication acts like given environment to complete routing contribution [1].

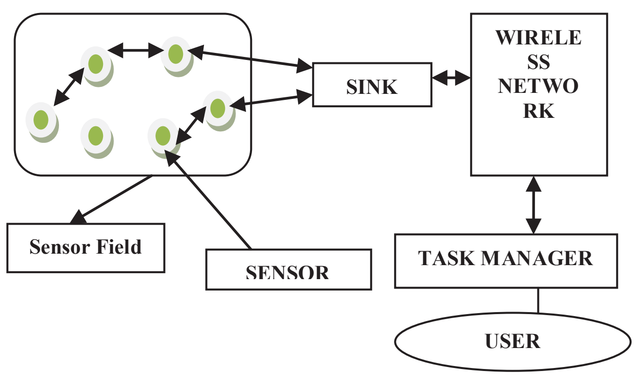

Fig.1 Architecture of sensor networks

WSN nodes are battery powered on demand basis, the limitation for routing protocol is to consume less energy and also it should be ensured that the information transfer delay should be less. Various routing protocols are available for wireless networks. In Direct communication, each node communicates directly with the base station. Diffusion based algorithm is utilizing only location data. E3D: Diffusion based algorithm utilizing location, power levels, and node load. Dynamic Source Routing (DSR) [2] and Ad-hoc On-demand distance Vector (AODV) [3] are possibly the most popular of all routing protocols. Location Aided Routing (LAR) [4] introduces the concept of routing using geographical positions of nodes. It also introduces the composition of the use of smart flooding to build the routes. Nevertheless, it is still the source routing protocol for ad hoc networks. Low Energy Adaptive Clustering Hierarchy (LEACH) is the first routing protocol for WSN. However, LEACH is unsuitable for use in most environments that do not involve base station routing or data aggregation. Greedy Perimeter Stateless Routing (GPSR) protocol makes use of the IEEE 802.11 MAC layer [5] and suits well for symmetric ad hoc networks. However, none of these protocols support an optimal mode for delivering messages efficiently in a WSN. In this it is found GPSR happens to be a better choice among other protocols and an optimized GPSR is being proposed in here and proved to support for delivering data-messages efficiently in WSN.

GPSR protocol is basically used for geographic routing with greedy forwarding to bypass obstacles. It gradually learns the capability to sense the presence of obstacle. When location information is not given directly then it is solved through optimization to satisfy the location-based queries.

1.1 Advantages of greedy forwarding are:-

1. Greedy routing scheme scales better than shortest path and ad-hoc routing.
2. It scales better as the number of destination increases.
3. It scales better under continues frequent topology changes.

WSN is required to adopt optimization to achieve its design goals in terms of efficiency of the network. In order to locate data correctly, various levels of data integration techniques should be synchronized towards the sink [6].

II. TYPES OF NETWORK

a. Ad hoc Networks: These are infrastructure-less networks having no centralized control. They have no dependency on pre-occupied infrastructure. These decentralized type networks have a wide scope in applications like post-disaster rescue operations, military operations, medical facilities, business decision etc [7], [8].

b. Sensor Networks: These are the networks embedded with transducers to measure different physical parameters like temperature, humidity, speed, vibration intensity, sound intensity, illumination intensity, chemical concentration, pollutant levels, wind direction, pressure [9].

c. Rooftop networks: It is basically used in roof top areas for telecommunications in a densely deployed metropolitan area with respect to the line of sight phenomenon. It also provides conventional infrastructure in case of disaster. It has significant impact on scaling regarding self configuration without any need of trusted authority [10].

III. GPSR

The micro-electro-mechanical systems (MEMS) led to the development of tiny sensor nodes with logic functions, monitoring physical conditions and communication capabilities. The limited processing and communication capabilities of sensor nodes, as well as the restricted energy resources available for sensor nodes, making the routing problem has increasingly become an issue and tedious task in wireless sensor network consist of these small size sensor nodes. Among plenty of existing routing protocols, Greedy Perimeter Stateless Routing (GPSR) protocol proposed by Brad Karp and H.T. Kung of Harvard University has been showing good performance over other protocols due to its efficient packet delivery success rate and lower routing protocol overhead and collisions. However, the efficiency of GPSR protocol mainly comes from its greedy forwarding mode which takes full advantage of the wireless network communication link. The completeness of GPSR is primarily dependent on its perimeter forwarding mode which can be carried out when the greedy forwarding mode fails, thus avoiding the entire protocol being in invalid. This feature of the GPSR making it a model in wireless routing protocols based on the geographical locations [11]. Meanwhile, the perimeter forwarding mode has also become the bottleneck of the protocol.

GPSR's modeling adoptions are:

1. GPSR is 'nearly stateless', i.e., its topology depends upon a single hop, requiring knowledge of intermediate neighbor's positions [12].
2. The topology adoption depends on the network density.
3. Bidirectional radio's reach ability.

Gabrial graph (GG) and Relative neighborhood graph (RNG) planar graph algorithms are adopted in GPSR. In order to avoid causing network partition in the topology, the cross edges in the topology need to be removed with the help of GG and RNG algorithms [13]. However, the connectivity of the graph may be destroyed due to the special mode of obstacles among the sensor nodes. Thus, a face is not able to reach another neighboring forwarding face, leading to the problem of destination node being unreachable. Aiming to solve this problem, the node-disjoint multipath was achieved so as to improve the reliability of data delivery in wireless sensor networks. GPSR has greedy forwarding decisions using information about router's immediate neighbors in topology of the network. When a packet reaches a region where greedy forwarding is impossible, the algorithm recovers by routing around the perimeter of the region. As the number of destination increases, GPSR gives better pre-route scalability than others existing ad-hoc routing protocols. As the data overhead changes, GPSR uses local topology to form new paths without congestion. The two dominating factors for efficient routing are:-

1. The number of routers in routing domain.
2. The network topology change during routing.

GPSR is useful to get immediate decisions from its neighbor's positioning. Hierarchical manner and caching are basic approaches to deal with scalable topology.

The measures of scalability are:

1. Routing protocol message cost
2. Packet delivery success rate
3. Per node storage capability

Finally, GPSR keeps state proportional to the number of its neighbors.

IV. OPTIMIZED GPSR

Optimization is the process of making any technique better. It is the process of adjusting the parameters of a device to get the minimum or maximum output or result. In this paper genetic algorithm (GA) is used to find an optimal solution. The GA utilizes the genetic operators such as selection, cross over and mutation for manipulating the chromosomes in a population [14].

The proposed routing approach is based on the fact that the energy consumed to send a message to the destination is less than the energy needed for un-optimized GPSR protocol. GPSR protocol is enhanced through optimization using GA at aggregation node. Aggregation node is responsible for delivering messages to the distant base station and routing is based on head set members. The head set is chosen on a routine basis related to the energy level of the signal received to the base station at the time period of "hello packets". At one time, during simulation, only one member of the head set is active and the remaining head set members are in sleep mode. The task of transmitting data to the base station is uniformly distributed among all the head set members. Each cluster has a head set that consists of several virtual cluster heads.

The sensor nodes sense the advertisements and pick-up their cluster-heads based on the signal strength of the advertisement messages. The acknowledgement is sent by sensor node to its cluster head. The next task of cluster head is to choose a set of associates based on the signal-strength of the acknowledgements. The head-set participation in routing is basically depends on its signal strength. After some pre-determined interval, the next associate becomes a cluster head and the present cluster head will becomes a passive head set member. The cluster head optimized formulation is based on the energy level consumption in the network. The energy consumption and head set size both are directly proportional to each other. The power consumption of the network depends on the optimization of head-set. In the network, the clusters are made with their respective headsets to decide the route passage from source to destination. The routing table is organized to make the optimal route with respect to shortest path, less delay and energy consumption. The optimal route decision is decided by shortest delay path and less energy consumption in the network as shown in the flowchart represented in Fig.2. In WSN, optimization is a critical component under given environmental conditions. It is very necessary to minimize the transfer overhead to make it energy efficient and more effective as compared to traditional approaches [15]. Maximum utilization of network coverage and target tracking in WSN has proven to be an interesting demand for it under optimization utilization for researchers. Optimization helps WSN to have an improved deployment by choosing an appropriate optimization technique [16].

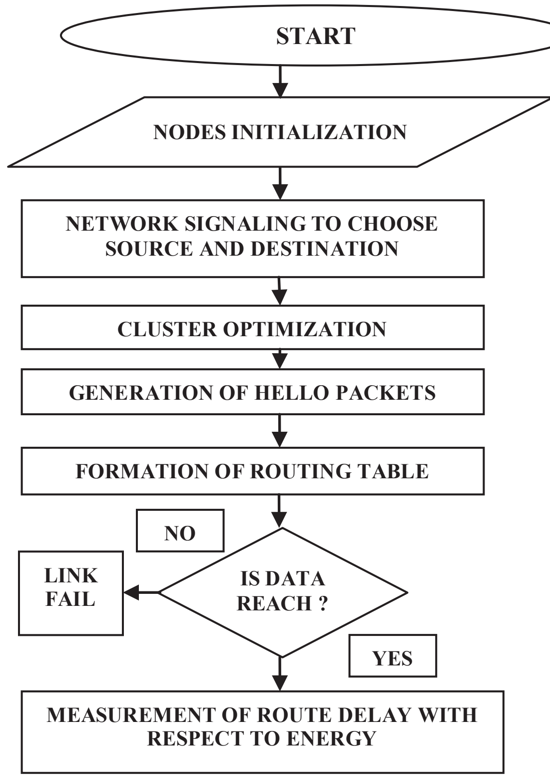

Fig.2 Flow chart of optimized GPSR

Handover performance is usually judged by the number of handover, latency, lost packets, band width. Optimization of loss packets are deal with genetic algorithm. Packet loss is the major concern in today's wireless networking during handover. Optimization of packet data loses in network design is essential in order to improve the mobility performance. Simulation of GA has been done on NS-2 with optimized results. A GA allows a population composed of many entities to evolve under selection rules to state that maximizes the "fitness".

V. RESULT OF OGPSR

In OGPSR (Optimized Greedy Perimeter Stateless Routing) "hello data packet" in head set composition is sent to all the nodes which are within the range by applying flooding technique. The formation of routing table is made after tracking the flooded packets. Different paths to deliver the packets are found, after ensuring the data reach ability, routing table is formed. Once the routing table is formed, the optimal path is selected based on packet delivery delay and having less energy consumption with the corresponding number of hops.

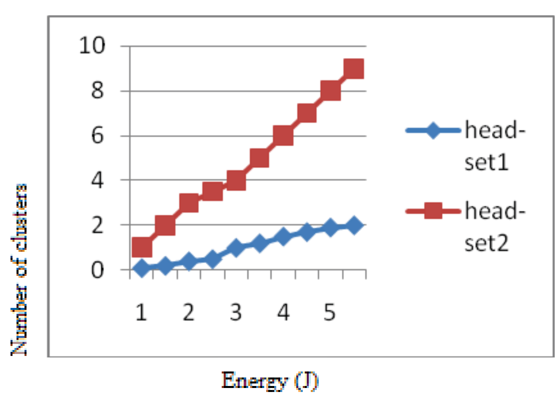

Fig. 3 Maximum number of clusters

The time taken by the 'hello packet' to reach the destination is identified. Fig.3 shows the transmission for different paths in head set1 and head set2 with less energy consumption. The optimal route is identified with increasing time of transmission of number of clusters as shown in Fig. 4.

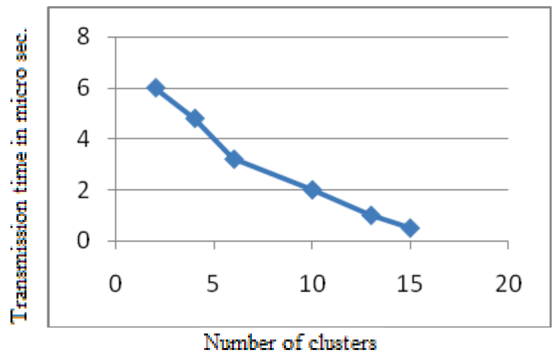

Fig. 4 Packet delivery del

VI. CONCLUSION

The optimized GPSR routing protocol is required for getting the unique requirements for sensor network applications. It is suitable for a robust, energy efficient routing protocol with the efficient delivery of packets under situations of non-uniform transmission ranges. The result of proposed optimal routing shows that the energy consumption can be decreased by optimizing the clusters symmetrically. The energy efficiency of the network is enhanced by ensuring the reach ability of data to the destination. If traffic density is more, then an alternative path needs to be selected with the shortest path of optimal energy with less energy consumption.

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