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A Multiple Aggregative Path Scheme for Optimal communication in WSN

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Abstract: One of the major challenges for any network is the effective routing to perform reliable communication over the network. This challenge becomes more critical for sensor network where each node is having the limited energy. To provide the reliable communication a distance and energy based optimal path is selected by most of the authors. But if the communication is performed regularly over such path, the energy of all intermediate nodes will be degraded and it will disturb the energy balance over the network. To provide balanced energy consumption, a multiple path multiple aggregative approach is suggested. In this approach, a corner based partition scheme is implemented. Number of dead nodes after a fixed number of rounds is very less as compared to existing approaches.

Keywords: Aggregative approach, dead nodes, Effective routing, optimal path

I. INTRODUCTION

A sensor network is one of the most growing network phenomenons that are having its importance in different real time applications. Sensor network has become the part of many application areas like vehicular network, medical application, body area network etc. With the increase of its importance, a lot of advancement is already done in the sensor network in terms of its capacity, low power functionality, multifunctional nodes, low cost, smaller size etc. These sensor nodes are capable to communicate effectively for small size network and for short distances. These sensor nodes works on a set of instructions called routing protocol. Different types of routing protocols like flat, hierarchical, location based, etc are used for designing sensor nodes in WSN depending upon network structure. Types of nodes present in a WSN are mainly source, intermediate and sink nodes. When we compare the WSNs with ancestor ad-hoc networks, we see that WSNs are resource limited, they are deployed densely, they are prone to failures, the number of nodes in WSNs is several orders higher than that of ad hoc networks, and topology in WSNs is constantly changing

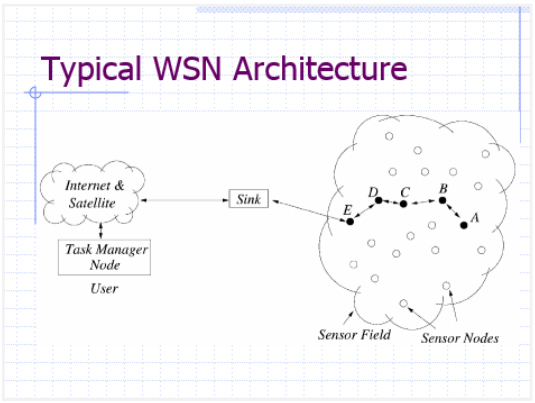

Fig 1: Architecture of a WSN

The major components of a typical sensor network as shown in fig 1are:

Sensor Field: A sensor field can be said as the area in which the nodes are placed.

Sensor Nodes: Sensors nodes are the heart of the network. They are in charge of collecting data and routing this information back to a sink.

Sink: A sink is a sensor node with the specific task of receiving, processing and storing data from the other sensor nodes. They serve to reduce the total number of messages that need to be sent, hence reducing the overall energy requirements of the network. Sinks are also known as data aggregation points.

Task Manager: The task manager also known as base station is a centralized point of control within the network, which extracts information from the network and disseminates control information back into the network. It also serves as a gateway to other networks, a powerful data processing and storage centre and an access point for a human interface. The base station is either a laptop or a workstation. One of such advancement is represented by the smart sensor nodes called smart dust. Smart dust has become most effective sensor devices that provide the autonomous sensing and computing along with memory storage. Smart dust provides the easy way communication within the network as well as provides the interaction with other connected nodes or devices. The main advantage of the sensor nodes is its continuous monitoring capability, data gathering and the intelligent decision making capability. The basic properties of smart sensors are shown in figure 2.

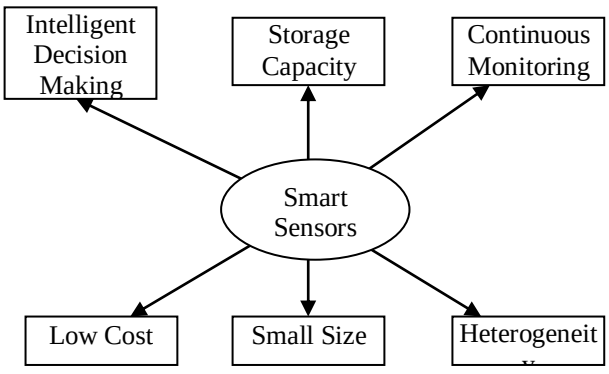

Fig 2: Capabilities of Smart Sensor

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The main features of the sensor network, that make it significantly effective low power communication, are given as under.

(i) Size: As the sensor network is provides intelligent decision making and memory storage, it able to handle large network with thousands of nodes. It can also be established in a network with large physical area as the power consumption in multi-hop communication is also lesser than traditional networks.
(ii) Mobility: In most of the cases, the sensor nodes are placed at fixed location. But smart sensors can be used in applications where the node mobility is required such as underwater sensor network, vehicular network etc.
(iii) Information Transfer: Smart Sensors can be deployed in such harsh environment and unexpected situations where the node failure is common such as sensor node placement in battlefield. In such networks, sensor node provides the information saving and transfer, if the node life is expectedly lesser.
(iv) Improved Life Span: Even the sensor nodes are defined with limited energy specification and with each communication some energy loss occurs. Smart sensors are capable to improve the node life because of its storage capability, lesser power consumption capability.
(v) Dynamic Decision: Smart sensors are capable to take the dynamic decisions about the information transfer.

The major challenge for the smart sensor network is to provide the reliable communication along with lesser power consumption. The basic characteristics of reliable communications given as under:

End-to-End Communication: The foremost requirement of smart sensor network is to provide high throughput. The end to end packet delivery must be higher and the packet loss over the network should be minimum.

***Lesser Conflict*:** If the network is performing the multi path communication, the confliction should be lesser. It means the path selection must be effective so that the node repetition as the intermediate nodes will be minimum.

***Lesser Latency*:** A sensor network can have congested communication but in all cases, the latency over the communication should be lesser. If the communication is performed over the alternate path, even then the communication delay should be lesser.

In this paper, an improved routing scheme is suggested under the capabilities of the sensor network. In this section, a brief introduction to sensor network and smart sensor network is defined. The work also defined the properties of reliable routing and reliable network. In section II, the work already done in the area of shortest path routing and alternate path routing is defined. In section III, the presented work methodology and routing scheme is explored. In section IV, results are discussed and in chapter V, conclusion driven from the work is defined.

II. LITERATURE SURVEY

Lot of work is already done to optimize the routing in mobile and sensor network. Some of work done by the earlier authors to optimize the routing is described in this section. In year 2003, Chao Gui has defined an optimized routing approach for the self healed mobile network. Author defined the optimality under different communication metrics such as energy consumption, route length, number of intermediate nodes, energy awareness and the load analysis. Author defined a framework to provide the optimize route selection in mobile network. Author defined a sub path analysis based scheme under the node monitoring scheme to optimize the routing [1].In year 2002, akyildiz represented the concept of sensor networks which had been implemented by the combination of micro-electro-mechanical systems technology, wireless communications and digital electronics[2].
Jiejun Kong in year 2003. Author defined the effective routing in hostile critical environment. Author focused on two main network problems called route anonymity and the back flow effecting destination effective routing so that the location privacy will be achieved. Author defined the routing in real scenarios[3]. S.Satish provides the route optimization using Ant Colony approach. Author defined the cache oriented analysis under the source initiated routing approach so that adaptive energy optimization will be achieved[4] In year 2011, Giovanni Comarela has defined the robot routing in sensor network under the Ant Colony optimization. Author defined the inclusion of travelling salesman approach to provide the effective routing and also provide the improvement by using the heuristic search. Author defined the comparative analysis with different approaches [5]. Another work in same year was proposed by C. D'Souza to obtain the energy effectiveness by performing the effective node placement in sensor network. Author used the swarm optimize approach to reduce the energy consumption[6]. In year 2012, Jing-Hui Zhong has defined ACO based routing approach to improve the network life and to increase the network communication. Author utilizes the network characteristics in an effective way and increase the network responsiveness [7]. Based on the finding of authors, conventional protocols like direct transmission, minimum energy transmission, multi-hop routing and static clustering may not be optimal for sensor networks, so they propose LEACH (Low-Energy Adaptive Clustering Hierarchy). LEACH is a clustering based protocol that utilizes randomized rotation of local cluster based station (cluster-heads) to evenly distribute the energy load among the sensors in the network. It uses localized coordination to enable the scalability and robustness for dynamic networks[8] This paper proposes a routing protocol based on PEGASIS by using an improved ant colony algorithm rather than the greedy algorithm to construct the chain. This PEG-ant as compared to PEGASIS can achieve a global optimization. It forms a chain that more even-distributed and total square of transmission distance much less[9]. This paper presents Greedy Perimeter Stateless Routing (GPSR). It is a routing protocol which is used in datagram networks and takes

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routing decisions based on the position of routers and a packet's destination. In this way, packet forwarding takes place by choosing most optimal path. It can be done by using information about a router's immediate neighbours in the network topology. [10]. This paper gives the concept of multiple chains in a network with each chain's topmost node (called the aggregator) collecting the data from the nodes beneath it and transmitting it to the sink. In the proposed scheme, a chain in each region works as PEGASIS. We also study how considering heterogeneity in the network can improve the lifetime of a network by a significant period [11].

III. RESEARCH METHODOLOGY

In this paper, an effective reliable, efficient and energy effective routing approach is suggested in this work. The presented work is defined on a smart sensor network in which each node is defined with some smart capabilities. The most effective properties of these sensors are the storage capability and the ability to take the decision making along with integrated processing. The main base of the presented work is to provide the energy balanced communication over the network. To provide this balancing, instead of communicating the data over a fixed static path, an array of the network paths is defined in this work. As the nodes are defined with memory specification, at the earlier stage, all the possible paths are generated and stored in the available memory. These paths include the shortest path as well as alternate paths under the energy effectiveness and the load effective analysis. These paths are generated in such a way that the intermediate nodes of a path will not be included in other path. Now these paths get activated in a sequence so that each time a separate path will be elected for the communication. A time-slicing approach is suggested in this work to activate these stored paths. The main objective of the work is improve the network life and to provide the reliable communication over the network. In this section, the assumption, working and the algorithmic approach of the presented work is explained in detail

3.1 Assumptions

a) All the network nodes are defined at static location.
b) The base station is placed at the centre of the network.
c) Multiple source and single destination points are described so that effective route will be generated.
d) Nodes are defined with energy specification and with each participation some energy loss will be done.
e) All the sensor nodes are homogenous but they are having different congestion factor and the energy level.
f) All nodes are having some memory to store the associated paths.
g) Nodes are defined with decision capability about the next hop selection.
h) Each node is defined with a bit as the route participation node.

3.2 Work Description

The main idea of the work is to provide the switching path capability so that the load over a particular path node will not be increased. The work includes the route generation under

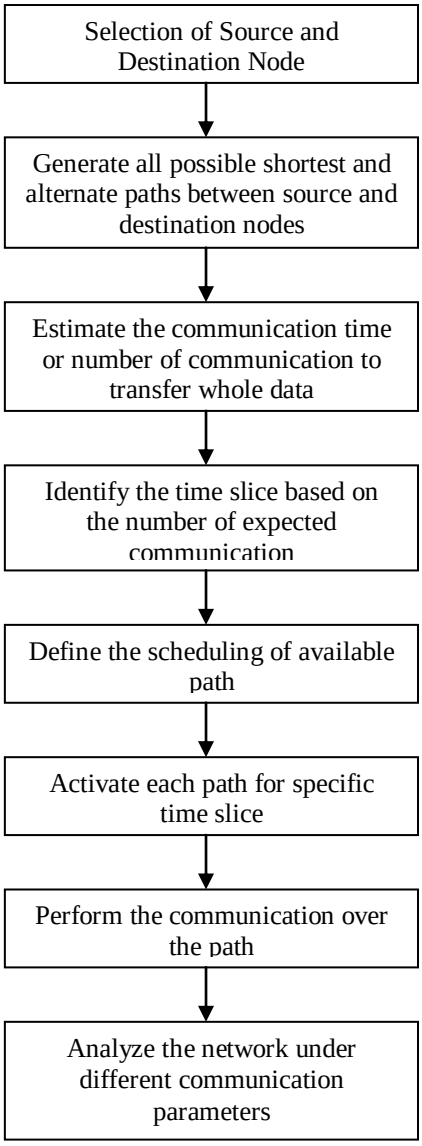

Fig 3: Process flow

different parameters at the initial phase and stores them in the memory of source node. Now activate these available paths one by one under the time slicing mechanism so that the no load on any intermediate node will be increased and an effective communication will be done over the network. The main stages of the presented work are shown in figure 3

IV. RESULTS

The present work is simulated in MATLAB environment. A comparison of proposed approach with the existing one has been made here. In earlier stages, the difference in count of dead nodes is very high. The proposed approach shows greater improvement over longevity of network as

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compared to the existing PEGASIS approach. The simulation is done for 3000 rounds.

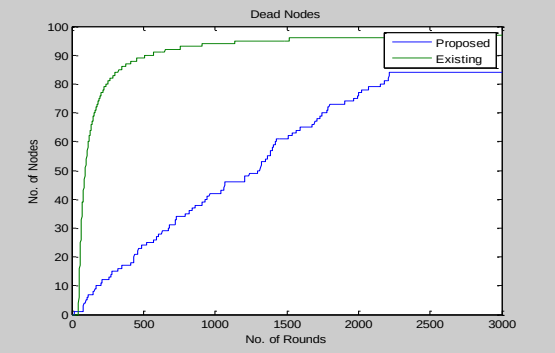

Fig 4: Comparison of dead nodes in existing and proposed work

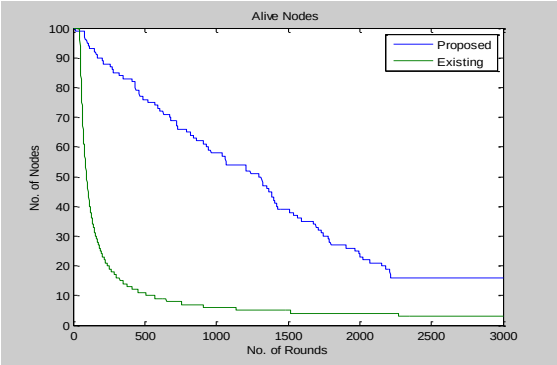

Fig 5: Comparison of alive nodes in existing and proposed approach

A node initially is provided with some fixed amount of energy. Here, in this work, the amount of energy depleted during transmission and reception of a packet by a node is 50nJ. While, the energy spent in forwarding a packet is 10nJ.
So total depleted energy say, 'E' is calculated as,

E= Transmitting energy of source node+ ((T+R+F)*No. of intermediate nodes) + Receiving energy of sink node.
Where, T= Transmitting energy of intermediate nodes
R=Receiving energy of intermediate nodes

F= Forwarding energy of intermediate nodes

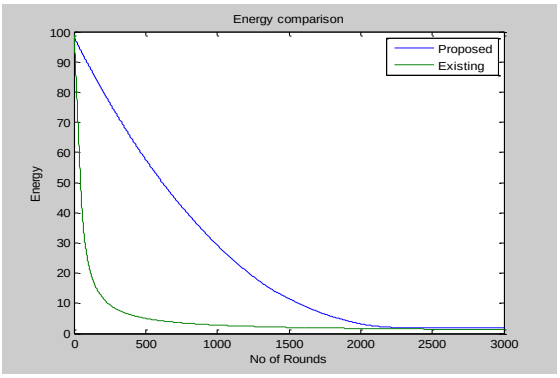

Fig 6: Energy consumption comparison between existing and proposed approaches

Comparison of energy consumption shows that energy dissipation is very less in proposed multiple aggregation path technique.

V. CONCLUSION

In this presented work, an effective alternate path based energy balanced routing is suggested. This work is based on the smart sensor network where each node is capable to store the possible paths and these nodes get activated under the scheduling mechanism.. Each node chooses most effective route and forms chain to carry out transmission. Many such chains work simultaneously in different partitions and saves time. The proposed approach is far effective than existing one, as number of alive nodes at the end of decided rounds are very high in count in proposed work than existing PEGASIS work. This suggests that energy depletion in network is very low in case of proposed approach because number of hopes is reduced .Hence it increases lifetime of a WSN network.

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BIOGRAPHY

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