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A Proposed Architecture Over Energy Efficient Routing Configuration in WSN

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Abstract: In typical sensor network application scenario the real time data collection and maximizing network life time are the most important task. In sensor network a mobile sink node moves into the sensing area or a node is activated to serve as a cluster head and collect data from the sensor nodes deployed in the area. But collection of data and processing data consumes the enormous amount of energy. In sensor network the data transferring from leaf node to end user is done by two methods, such as Single hop communication and multi hop communication. But both communications suffer from some disadvantages like wastage of energy and node isolation problem respectively. So in this paper we proposed architecture for sensor network in which Cluster Terminal is introduced which solves major problem faced in the previous communication methods and we proposed an algorithm for energy-efficient design and analysis of novel architecture that can dynamically configure a network to achieve guaranteed degrees of coverage and connectivity.

Keywords: Cluster Head, Cluster Terminal, Single Hop, Multi Hop

I. INTRODUCTION

WIRELESS sensor networking is an emerging technology that has a wide range of potential applications including environment monitoring, smart spaces, medical systems and military applications. Such a network normally consists of a large number of distributed nodes that organize themselves into either single-hop or multi-hop wireless network based on application. Each node has one or more sensors, embedded processors and low-power radios, and is normally battery operated. Typically, these nodes coordinate to perform a common task.

The main objective of wireless sensor networks is to disseminate network state information effectively, with the most desirable performance objective being to minimize the consumed energy while maximizing the network capacity. But due to the often hostile nature of such networks, a related challenge is to determine the most reliable and energy efficient routes so data from the sensor nodes can be reliably delivered to a base station. Previously, these problems are addressed by splitting the network into clusters, with each cluster having a cluster head (CH), with data being delivered to the CHs via either single or multi-hop communication [3,4]. The CHs are given the role to aggregate the data received and then deliver it to the base station. As the network usually comprises of numerous tiny sensor nodes, the data is routed via intermediate nodes to the sink node and thus saves sending node energy in multi-hop data transmission. But the key challenges for the CHs are associating the number of nodes with CHs and collect the information over the same nodes. The association of node with the CHs will be the key issue. In general from a typical network it is expects that information exchange has to be minimal, timely, efficient and non erroneous between child nodes to CHs and CHs to sink node. The two main deficiencies of these approaches that Energy associated with the CHs and time required to aggregate the data by child nodes. Thus the traditional way of aggregation and transferring the data will become in-efficient as scale of sensor network increases. So to avoid this problem we proposed a concept of energy efficient cluster terminals (CTs).The CTs are similar to CHs but they present in the granular level i.e. the CHs are again divided into the sub clusters and for these small cluster and group leader will be elected based on energy, concentration and centrality and that node is known as Cluster Terminals (CTs) [6]. The number of CTs will be based on one third of total number of nodes in that CH. In this paper, we present a novel energy efficient technique that can find new way of associating the leaf nodes to the cluster terminal and heads in the high density clustered WSNs. Our approach is expected to improve energy efficiency and prolong the overall network lifetime.

The rest of this paper is organized as follows. In Section II, we briefly explain concept and proposed architecture of network model. In Section III, provides a discussion of future work and our conclusions.

II. PROPOSED ARCHITECTURE

In order to minimize energy consumption, the proposed architecture makes two important modifications over the existing way of building CHs in the sensor network. In our proposed architecture we try to avoid darning out of the energy in the granular level for sensor network architecture. The sensor network architecture can be differentiated into two types. One is single-hop clustering architecture and another one is multi-hop clustering architecture. The salient features of a single hop sensor network [Fig 1] is that all the nodes are identical, the simpler design guarantee a certain network lifetime and a very little residual energy left behind because all nodes expires at same time. Since each node has to be capable of acting as a cluster head, so they are capable of performing

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long range transmissions to the remote base station. But an disadvantage of single hop is the cluster head nodes are predetermined, and leaf sensor nodes uses single hop communication to reach CHs, but nodes near the periphery of cluster will suffer the have highest energy drainage [1].

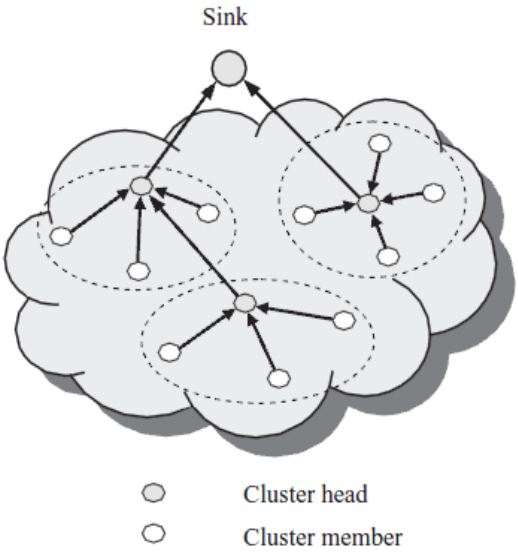

Fig1. Single Hop Clustering Architecture

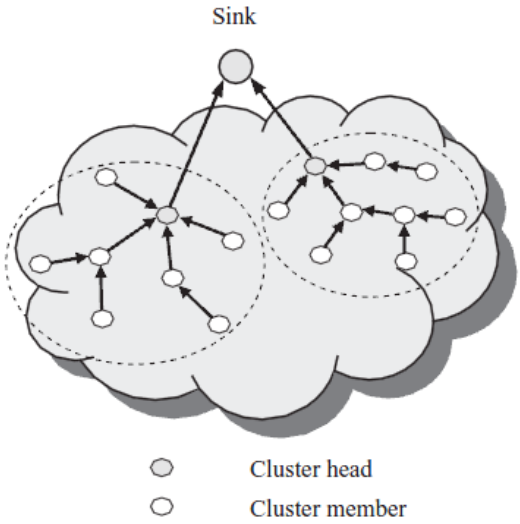

Fig2. Multi Hop Clustering Architecture

Next, Fig3 shows multi hop architecture, it was observed that single hop communication within a cluster for communication between the sensor nodes and the cluster heads may not be the optimum choice. However when sensor nodes are deployed in regions of dense vegetation or uneven terrain the single hop path communication will become impossible and nodes needs to spend more amount of energy for the transmission of data. In typical dense condition it was assumed that each CH is connected with 'm' number of leaf nodes (where m>0) which leads to rapid depilation in its energy. So to avoid this problem multi-hop communication will be used [5]. The multi hop communication also suffers from problems like the end-to-end delay may be higher as compared to that of single-hop transmissions, especially when congestions occur due to high traffic loads, the multi hop communication leads to complex structure and suffers from node isolation issue. So to overcome the problems raised from single hop architecture and multi hop architecture we propose a new architecture i.e. Cluster Terminal based single hop communication.

The CTs based communication architecture is the combination of single and multi hop architecture. In this architecture we tried find the solution for saving the energy of node which lies at the periphery of cluster, to make network architecture simpler and robust and mainly to avoid the node isolation problem also to reduce access burden building over CHs for computing the sensed data. In our proposed concept we define a concept of Cluster Terminals (CTs) which were assumed that they lie at one hop distance from the leaf nodes.

The Cluster Terminals are same as of the Cluster Heads (CHs) i.e. they are next eligible nodes who opt to become the CHs. But the cluster terminals were differ by a condition with respect to cluster heads i.e. the cluster terminals always at one hop distance with respect to the nodes with which they were connected and an cluster terminal is at most it can connect with maximum four nodes. But in those four nodes three nodes will are regular nodes and fourth node is spare node which is known as isolated node because it is not connected with cluster head or cluster terminal. Where the cluster head is connected to the both cluster terminals and nodes which are laying nearer to cluster heads at one hop distance.

In the cluster terminal architecture the energy wastage can be saved in two areas, one is at cluster heads and at leaf nodes. Considering a situation where environmental temperature is to be measured by using the single hop architecture. It was assumed that 'n' numbers of nodes are connected to the each cluster head. So a temperature variations occurs across the deployed field then node will start sensing the data and transmit data to the CHs based on event happened.

Thus cluster head needs to transmit all the gathered data to sink node at different instances continuously so this leads to the extra burden to compute the data and transmit it to sink node for this process huge amount of energy is used. And another problem is with respect to nodes laying at peripheral of cluster is solved using the cluster terminal architecture.

The Fig 3 represents the cluster terminal architecture where each nodes are connected with an cluster terminal via single hop communication so as this the nodes needs to use only small amount of energy to communicate the data and then the CTs will aggregate the data of nodes and then it will transfer the data to the either CHs or CTs based upon its position. The CTs to CTs communication will be based on shortest path algorithm [3].

So by this the overhead of aggregating data at CHs level will be reduced drastically and the peripheral nodes will consume little energy for transmission. Thus cluster terminal architecture makes network robust and reliable.

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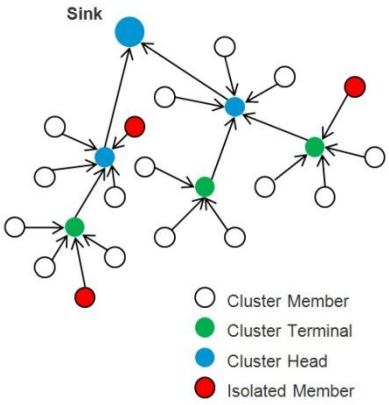

Fig3. Proposed Cluster Terminal Architecture

Next problem to be addressed is isolation node problem in multi-hop communication that can be solved by the proposed architecture. Here the each cluster terminal can be configured with at most four nodes in that one will be SOS node (isolated node). It was found that node isolation problem may happen when a cluster terminal was restricted to get connected with only three nodes. So in this case some nodes may remain unconnected. Thus the solution for this problem is given by implementing spare node concept. Thus this problem solution was explained the Algorithm 1.

Algorithm 1 At Cluster Terminal

```
1:  if (message equals SOS) then
2:    if (Cluster terminal Connection <= 3) then
3:      if (Spare Connection > 1) then
4:        Ignore SOS message
5:      else
6:        Send response to SOS
```

When the cluster Terminal node detects the message as SOS (Saving Of Sensor node) type then it will check for total number of node connections if the reserved slot for spare connection is vacant then CT will send the response for it else it will not respond to the SOS message.

Algorithm 2 At Isolated Nodes

1. **while** (Send SOS message)
2. **if** (Any SOS Response) **then**
3. Response(List1)
4. Resend SOS message
5. Response(List2)
6. AVG List = average of both response list
7. Send CONNECT message to CT which has least response time
8. **if** (CT is dead which has least time) **then**
9. Send CONNECT message to CT which has second least response time.
10. **else**
11. 11 count++
12. go to:1
13. **if** (count > 3) **then**
14. go to sleep
15. /* *Response function* */
16. Response (list)
17. collect CT Responses in list

The process at isolated node is presented in Algorithm 2.here initially isolated node sends an SOS message over the network. The cluster terminals which still remaining with spare node connects vacant in there connection will respond back to the isolated node. Then the isolated node will make list of responses. Then isolated node will perform the sending for SOS message again and it will make list of responses. This process is performed to avoid the single point failure. Then it will take average time of responses and then it will send the connect messaged to the CT to which it gets least time of response and if the CT is dead then it will send same connect message to the second CT which has got second least time of response in list. In worst condition if node does not get any responses from any CTs then it will perform above operation for three time then it will go to sleep mode until next global connect message is broadcasted by sink node so this leads saving of energy in the sensor nodes.

III. CONCLUSIONS AND FUTURE WORK

In this proposed architecture, we investigated new challenges faced in the communication architecture of wireless sensor networks for maximizing its life time by increasing its energy efficiency and gaining the accurate results by taking all nodes into account. In future we will study the further details based on the implementing MAC layer communication protocols in wireless sensor networks for building energy efficient and reliable communication network.

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