Energy Efficient Routing Using Random Walk and Best Route Selection for Sensor Networks

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Abstract— this paper discusses about a new routing technique based on the idea of random walk with the objective of saving energy. Energy consumption is a vital factor in the successful deployment of wireless sensor networks because sensor nodes are powered by on board battery which are extremely difficult to be recharged. Our approach is inspired by an existing TDMA like routing protocol. In this paper we have given a description of our algorithm by taking help of a small size network and performed simulations on large network to draw a comparative analysis with the existing algorithm.

Keywords— Sensor, Wireless, Network, TDMA, Routing, Battery, Energy.

I. INTRODUCTION

Among several challenges in wireless sensor network, efficient energy management is of particular importance, since sensor nodes are constrained by battery power which have limited amount of energy. This energy used in sensor networks is be very expensive and it is very difficult or even impossible to renew. Thus energy efficient techniques are critical to maximize network lifetime [1],[2].

Efficient energy management in ad hoc networks can be done in different ways considering energy consumption at multiple layers in the network protocol stack. Starting with the Application layer, methods can be developed to reduce the amount of data to send to consume energy. However, once the data is send by the application layer, it is up to the network to try to deliver it in an energy-efficient manner. At the network layer, intelligent routing protocols can reduce overhead and discover routes in energy efficient manner. At the medium access control (MAC) layer, methods can be used to minimize the energy consumed during transmitting and receiving data. Additionally, an intelligent MAC protocol can turn off the wireless communication device when the node is idle[3]. In a device network most of the ability is consumed for act between nodes, i.e. for transmission and receiving. so energy saving is directly proportional to the time a node stay in idle state (Neither transmission nor receiving) or reciprocally proportional to range of transmissions [4]. Therefore it's necessary to style a routing formula that should avoid or scale back redundant causation of messages. This can minimize power consumption by reducing the time that a node is transmission or receiving (duty cycle)[5],[6]. In impromptu state of affairs it's terribly troublesome if not not possible to route the message within the best path (in terms of hop count and time) in the main attributable to following constraints:
a) Network configuration isn't far-famed before.
b) The network being dynamic and nodes area unit mobile, best route between a combine of nodes might amendment, therefore it's necessary to calculate the recent route before every transmission.

II. PROBLEM STATEMENT

Given a network and a source-destination try, the matter is to route a packet from the supply to the destination node exploitation minimum number of transmissions or hop count. Assumptions- we have a tendency to create the subsequent assumptions:
a) every node is connected to one or a lot of nodes Within the network (neighbours).
b) A node is also a supply, a destination, or it's going to act as a router for a communication between a distinct try nodes.
c) Neither network configuration nor nearness data is understood beforehand.
d) an equivalent quantity of power is needed for causing a message between any try of adjacent nodes throughout the network.

III. PROPOSED APPROACH

In this approach, every node discovers its neighbours and agrees to speak with each of them solely throughout a little interval randomly(shown in fig 1). Thus every node

remains active throughout a little amount of the network time (T) and remains idle most of the time. Every node maintains a contact list containing the knowledge of its direct neighbours and adjacent nodes of its neighbours, beside the interval during which they convey. Therefore a Two hop node (two hop neighbours area unit referred to as as routers) list is maintained by every and each node. s".A queried node may be a node that has received the request to forward an information packet. Whereas causation multiple copies of same knowledge to completely different nodes (potential routers), the queried node can send a "tentative path list" containing the nodes to that constant knowledge is forwarded beside the time slots[9].

After choosing a router the queried node can generate a random range say x between zero and one. If x is a smaller amount than P, choose that router else discard it. By this we have a tendency to area unit proscribing the amount of transmission of constant knowledge thus saving energy[10].

In device network, since the nodes are also mobile the route between any two nodes could amendment with time. As a result when a node desires to send some knowledge it's to seek out the trail and therefore the knowledge packet is distributed whereas discovering the route and no separate message is employed for route discovery.
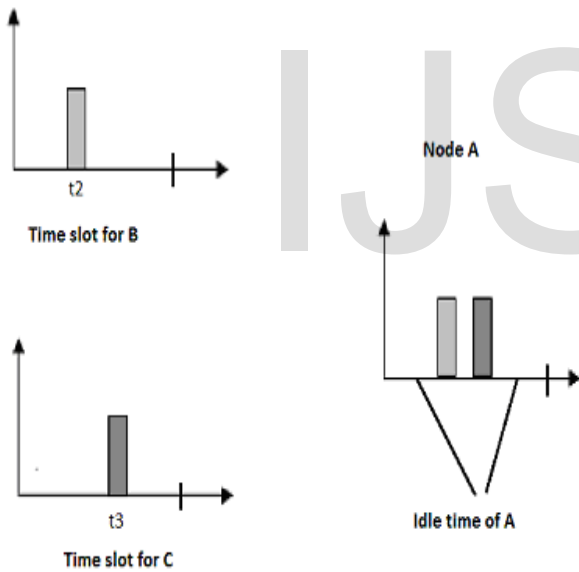

Fig 1: Communication time slots of node A

Proposed Algorithm:

1. Each node broadcasts its one level contact list; at the end of the process every node has an updated routing table with nodes reachable in two hops and corresponding time slots.
 2. A sender or a queried node will do the following:

   a)   **If** it has forwarded the packet **then** stop.

   b)   **Else if** final node in contact list **then** do not consider any other nodes.
   c)   **Else** find a router and select it with probability P from its contact list which is not:
      - The sender
      - a neighbour of sender and queried node
      - Those nodes which the concerned node knows have already been queried (those in "tentative path list")
      - neighbour nodes of nodes in "tentative path list" visible from current node.

3. **If** a final node or router says x is detected **then** evaluate P1 and P2 such that:

   a) P1=best route to x from current node (in terms of time delay).
   b) P2=best route to x (if reachable) among all nodes in the "tentative path list".

4. **If** time delay of P1 is less than P2 **then** send the packet to x **else** inhibit.

Example for above algorithm:

We contemplate the network given in fig. 2 to understand the operating of the algorithm. at first every node can discover its neighbours and broadcast this link info in conjunction with the corresponding communication time slots to every of its adjacent nodes. When the invention section each node has associate degree updated routing table with nodes approachable in two hops and corresponding time slots. The time slots assumed for bi-directional communication between every try of nodes is shown in fig. 3. The contact list of node A is shown in fig. 3.
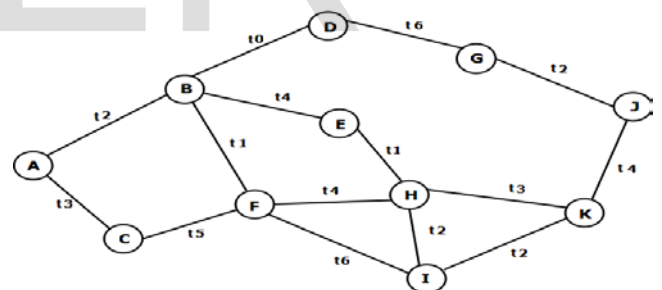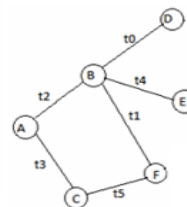

Fig 2: An example of sensor network showing the time slots agreed upon for bidirectional communication between each pair of nodes.

	B	C	D	E	F
A	t2	t3			
B			t0	t4	t1
C					t5

Fig3: Contact list of node A.

Suppose at network time T1, A needs to send a packet to J, since J isn't in its contact list it'll attempt to realize a router to forward the packet. The potential routers for A ar D, E and F. Let, say solely E and F is chosen at random, then whereas causing the packet to F, A can consult its contact list and selected the trail A-C-F that is accessible in time interval t5 of network time T1 (t5-T1), instead of the trail A-B-F that takes t1-T2 time (step 3-a of the algorithm).

Now E on receiving routing request at t4-T1 will resolve from the "tentative path list" that A has send an equivalent request to F at t5-T1. Since E cannot realize the destination node in its contact list it searches for a router among the nodes A, B, D, F, H, I and K to that it's access. However solely D and K may be its potential routers, since A is that the sender, B and H ar its neighbours, F is within the "tentative path list" and that i is that the neighbour of F (step 2-c of the algorithm). however before causing the packet to K it consult its contact list and "tentative path list" to finds that F will reach K in t2-T2 following the trail F-I-K that is best than its path E-H-K that takes t3-T2 time, therefore the best path is F-I-K (step 3-b of the algorithm).

IV. SIMULATION RESULT

We have evaluated the performance of our algorithm considering the subsequent networks:

a) A little network of fourteen nodes (say NW1)
b) A randomly generated network (say NW2)

with the subsequent parameters:

1. Range of nodes: sixty
2. Minimum connectivity of every node: one
3. Maximum connectivity of any node: six

We have compared the performance of the proposed algorithm with the existing algorithm [12],[13], using sample networks NW1 and NW2. We have tried to find out how different factors like number of requests and the control parameter P affect average number of transmissions and hence energy consumption. In fig. 4.1and fig. 4.2 average number of transmissions is plotted as a function of number of requests and the control parameter P, respectively. All the results have been obtained after performing 50 simulations and then taking their mean. The request sets are generated randomly and they are distinct for each simulation.

The average number of transmissions versus number of requests for a fixed value of the control parameter P (here 0.5) is shown in fig. 4. As seen from the figure, proposed algorithm performs better than the existing one for both the networks NW1 and NW2. It is interesting to note that as we increase the number of requests, average no of transmissions increase almost linearly. Further since slope of the line corresponding to the proposed algorithm is smaller than the existing algorithm, the plots diverge as we

increase number of requests. Hence we can predict that our algorithm will give even better performance for higher values of number of requests.
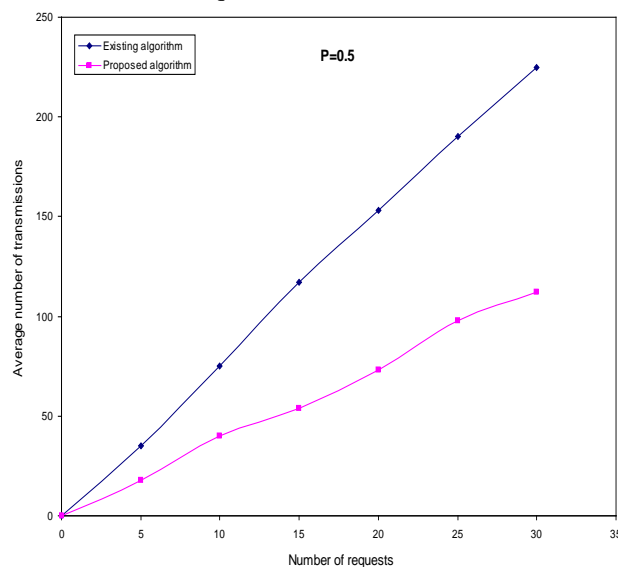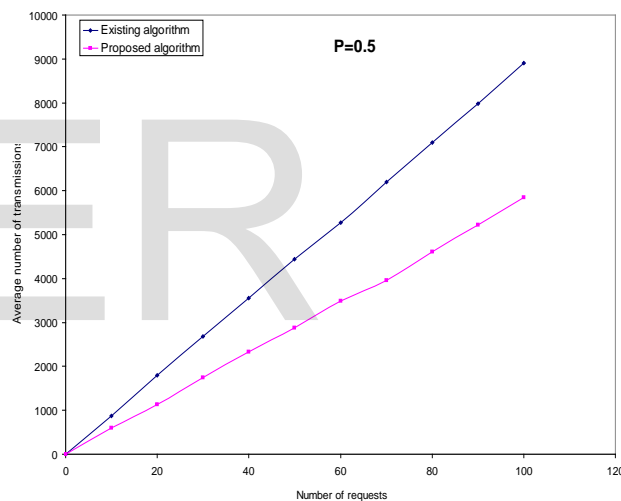

Fig 4.1: For NW 1

Fig 4.2: For NW2

V. CONCLUSION

For implementing the above algorithm first of all we have analysed some protocols of WSN with respect to some specified criteria's and then we have proposed an energy aware routing method for wireless sensor network using random walk. Our objective is to avoid redundant sending of information so as to reduce number of transmission hence conserve energy. When a node finds more than one possible routers it will forward the packet to a set of router depending on a control parameter p. By tuning the value of p we can control and restrict redundant sending of a data

packet. The algorithm is based on a decentralized approach and it maintains a very simple routing table.

The routing algorithm which we have proposed is an example of multipath routing which enjoys the advantage of being fault tolerant since more than one path from source to destination are discovered. The proposed technique results higher percentage of successful connections for larger size network for same value of P. This also leads to better distribution of the traffic load.

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