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Sink Resolution and Analysis in Wireless Sensor Network Using Matlab Simulation

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Abstract— **The major challenge in designing the Wireless Sensor Networks (WSNs) is to reduce the power consumption of each sensor nodes and thereby increasing the network lifetime. WSN has variety of applications in medicine, manufacturing, health monitoring, military etc. Sensors have the ability to collect data about surrounding environment, processing the data and transmitted these data to nearby sensor nodes and finally it reaches the sink node through these sensor nodes. Sink is also be a sensor node which collects the data from other sensor nodes in WSN , process the data and send them to the user through internet. The main problem in wireless sensor network is their lack of energy supply. When considering the operations of a sensor, the most expensive one is the wireless communication. A large number of densely deployed sensor node comprised to form wireless sensor network. Each sensor node is equipped with, a low power radio, one or more sensors, portable power supply and possibly localization hardware such as GPS (Global Positioning System) unit or a ranging device. Communication and networking are enabled using wireless transceiver. When sensor nodes are deployed in a region for particular application, that are capable for sensing the abnormal event occurred, processing the sensed data and transmitted these data to sink node by a hop by hop mode. Sink node is the superior node that is only connected to user through internet. The network lifetime of a WSN reduced due to the depleting speed of battery energy of each sensor node. To enduring the lifetime of wireless sensor network by designing energy-aware routings to conserve the usage of the battery energy. Avoid staying of sink node at a certain location for too long by using sink relocation mechanism otherwise which may harmful to the lifetime of nearby sensor nodes. The proposed work is to introduce modified dijkstra's algorithm for sink relocation and routing that relieves the burden of hot-spot problem and speed up the sink relocation mechanism and to enhance the performance of the prolonging network lifetime.**

Index Terms— **routing protocol, sink relocation, sink mobility, wireless sensor network.**

I. Introduction

Wireless Sensor Network (WSN) refers to a group of spatially distributed dedicated and autonomous sensors at diverse location for monitoring and controlling physical or environmental conditions such as temperature, pressure, humidity, moisture etc. and organizing the collected data at a central location. WSN has variety of applications in medicine, manufacturing, health monitoring, military etc. Today researchers utilize the sensor nodes with low power and are composed of wireless radios, sensors, and computing elements. The energy consumption of WSN can limit the effective life time of WSN nodes.[1] The major challenge in WSN is to Conserve the constrained battery resources of sensor network. Sensors have the ability to collect data about surrounding environment, processing the data and transmitted these data to nearby sensor nodes and finally it reaches the sink node through these sensor nodes. Sink itself is a sensor node which collects the data from other sensor nodes, process the data and send them to the user through internet. The main problem in Wireless Sensor Network is their lack of energy supply. When considering the operations of a sensor, the most expensive one is the wireless communication. A large number of densely deployed sensor node comprised to form. Wireless Sensor Network. Each sensor node is equipped with, a low power radio, one or more sensors, portable power supply and possibly localization hardware such as GPS (Global Positioning System) unit or a ranging device. Communication and networking are enabled using wireless transceiver. Self-organizing capability is the main feature of Wireless Sensor Network and their nodes are untethered and unattended. The most important design consideration of WSN is its energy efficiency. A small microcontroller, radio transceiver or other wireless communication device, and an energy source usually a battery are comprised to form each node in Wireless Sensor Networks. The size of a single sensor node can vary from shoebox-sized nodes down to devices the size of grain of dust. Depending on the size of sensor networks and the complexity required for individual sensor nodes, the cost vary from range of hundreds of dollars to a few cents.

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A. Wireless Sensor Networks

When sensor nodes are deployed in a region for particular application, that are capable for sensing the abnormal event occurred, processing the sensed data and transmitted these data to sink node by a hop by hop mode. Sink node is the superior node that is only connected to user through internet. Consider figure 1. it consists of number of sensor nodes and a sink node, Consider the situation that node a detects an abnormal event, it will send a warning message to the sink, then sink will inform this condition to the supervisor through internet. The predetermined routing path, say Pea = a-b-c-d. Depending on routing algorithm routing path may be static or dynamic. In data network, static routing the routes are described by fixed paths. The whole network can be configured by using static routes, these routers cannot adjust automatically in a network when traffic changes Dynamic routing protocols are the applications which discover network destinations dynamically.

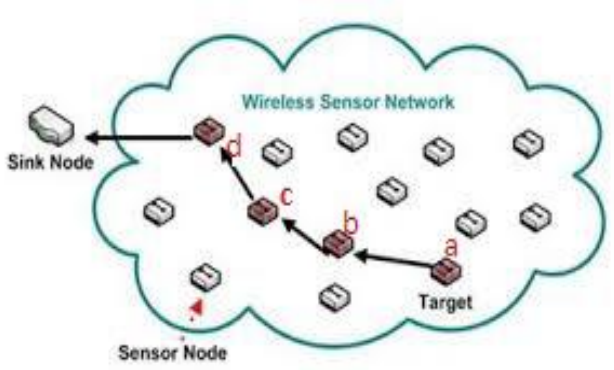

Fig1: Wireless Sensor Network

Routers will communicate the adjacent routers which informs the network to which each router is connected. These routers adjusts automatically in a network when traffic changes [1][2].

The rest of this paper is organized as follows. Section II presents recent advancements in WSN. Section III explores related works for sink relocation. Section IV introduces the existing system. Section IV introduces the proposed system. Section V explains analysis The paper concludes with section VI.

II. Recent Advancement In WSNs

Wireless Sensor Networks have come into prominence because they hold the potential to revolutionize many segments of our life. Wireless sensor networks constitute an emerging technology that has received consequential attention from the research community. Sensor networks are typically self-organizing ad-hoc systems that consist of many minuscule, low-cost contrivances. They monitor the physical environment, and subsequently accumulate and relay information to one or more sink nodes. Normally, the radio transmission range of the sensor nodes are typically orders of magnitude more minute than the geographical extent of the entire network. Thus, data needs to be relayed towards the sink node hop-by-hop in a multi-hop manner. The energy consumption of the network can be minimized if the amount of data that requires to be transmitted is also minimized. The computational potency, battery lifetime, data storage and communication bandwidth are the factors which affect the performance and reduces the efficiency of the WSN. In order to eschew consequential energy consumption and to ameliorate bandwidth usage, it is paramount to consider in the WSN architecture, the topology of network, consumption of power, data rate and fault tolerance. The main function of the WSN is to monitor the circumventing environment and to communicate in short distances.

The sensor nodes have wireless communication interface through which it can communicate with the other contrivances in its vicinity. According to the scarcity of the energy reservoir and due to the fact that the communication is the ascendant energy consumer, the transmission range of the sensor nodes is inhibited for energy efficiency purposes. One of the most paramount constraints on sensor nodes is the low power consumption requisite. Sensor nodes carry circumscribed power sources. Therefore while traditionary networks aim to fulfil high quality of service provisions, wireless sensor network protocols must focus primarily on power consumption [2][3].

III. RELATED WORKS FOR THE SINK RELOCATION

The EASR outline principally concentrates on when the sink will be triggered to perform the relocation process and where to move to. In addition to the sink relocation criteria, the full operation of the WSNs for environment monitoring also needs to bling the routing method for reporting the sensed data from the source node to the sink node, as well as the energy usage model. In this section, firstly briefly describe the energy consumption model for message relaying. Then, the energy aware routing protocol MCP is adopted in the EASR method [2].

A. Energy Consumption Model for WSNs

Consider *ET (m, d)* (and *ER(m)*) denote the total energy required for a sensor node to transmit and receive a *m*-bits length message to and from a neighbouring sensor node at distance *d* away, respectively.The energy used up for message transmitting (ET x(k, d)) can be divided into two parts. The first part is the energy used by the transmitted electronic component and is equal to $E_{elec} \times m$, where E_{elec} denotes the energy used by the transmitter or receiver circuitry. The remaining part is the energy used in the amplifier component and is equal to $E_{amp} \times m \times d$^n, where E_{amp} denotes the energy needed for the transmitter amplifier. The first part of the energy consumption is only used by the receiving process performed in a sensor node.

$$E_{Tx}(m,d) = E_{elec} \times m + \epsilon_{amp} \times m \times d^n \quad (1)$$

$$E_{Rx}(m) = E_{elec} \times m \quad (2)$$

IV. Existing System

The technique of energy aware transmission range adjusting to tune the transmission range of each sensor node according to its residual battery energy is incorporated in the EASR method the transmission range will be tuned to be small for energy saving, after performing rounds of message relaying and environment sensing task, in case of residual battery energy gets low. In order to gain the merit of enduring network lifetime, the sink that makes the relocating decision will take as the MCP routing protocol as the underlying message routing. The performance of the entire operating scheme may be affected by the underlying message routing method as the parameter of the routing algorithm change. Then choose the MCP over the EASR method to be incorporated with any existing routing method as the underlying routing method to limit the above mentioned influence. This is because the residual battery energy of the sensor nodes is the only parameter of the MVP same as the decision parameter of the EASR method. The energy-aware transmission range adjusting and the sink relocation mechanism are the two components of the proposed EASR [1].

A. Transmission Range Tuning of Sensor Nodes

To enhance the quality of the energy-aware routing a larger transmission range set for a sensor node will increase the number of neighbours. It also has the demerit of longer distance message relaying, that will consume more battery energy of a sensor node. To conserve the usage of the residual battery energy by shorten range of communication, but it does not help too much for routing. In the existing system according to residual battery energy the transmission range is adjusted. Sensor nodes in WSN are classified in to three depending on the residual battery energy and thereby adjusting the transmission range. Let *R be* the battery energy value when the battery energy is full in the beginning and *r (u)* denotes the current residual battery energy of a sensor node [1].

Table I: Types of nodes depending on battery energy

TYPES	CURRENT RESIDUAL BATTERY ENERGY	TRANSMISSION RANGE
Type I	$0 \leq r(u) < B/3$	$\gamma/4$
Type II	$B/3 \leq r(u) < B/2$	$\gamma/2$
Type III	$B/2 \leq r(u) < B$	γ

B. *Relocation mechanism of sink in WSN*

Sink relocation mechanism is classified in to two sections, first section is used to determine whether the sink relocation condition is met or not. For this consider the following figure 2, then collect the neighbours of sink node S and check whether the following condition is met or not.

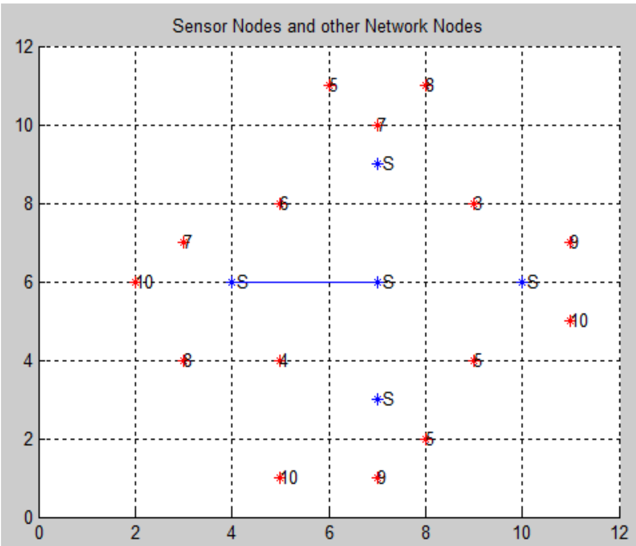

Fig 2 : Sink relocation mechanism

- Find the sensor neighbor u in N shows the battery value below BV/2.
- The neighbor sets residual battery energy drops below BV/2

For relocating the sink position, firstly determine the four candidate positions of sink to move to that are SC_1,SC_2, SC_3, SC_4 located in left ,right, top and down. Then choose any one of SC_j from SC_1,SC_2,SC_3 and SC_4.Such that weight value with respect to SC_j is maximum value among $w_i(1<=j<=4)$.EASR method will drive the sink to one of its candidate position with greatest w_j value [4].

C. *Time Complexity Analysis*

EASR scheme, that uses MCP as the routing protocol. But the time complexity for performing MCP is large. So the time complexity of EASR equals the time complexity of MCP.As time complexity increases network lifetime decreases and transmission range tuning will greatly reduce the battery charge of sensor nodes. So to avoid these problems, here introduce a new energy aware routing protocol called Modified Dijkstra's algorithm [1].

V. Proposed System

In proposed system the EASR method is modified by using modified dijkstra's as the routing algorithm. In WSN applications, Algorithm for finding shortest path between nodes considers the battery capacities of nodes. If one node has to be selected in shortest path, its battery capacity should be above a particular value. Therefore, for this purpose modifying the DIJKSTRA algorithm by including the battery capacity of each node besides the tentative distance[10][11].Basically, Dijkstra's algorithm is an algorithm for finding the shortest paths between nodes in a graph, which may represent, for example, road networks[10]. The algorithm exists in many variants; Dijkstra's original variant found the shortest path between two nodes, but a more common variant fixes a single node as the "source" node and finds shortest paths from the source to all other nodes in the graph, producing a shortest path tree. For a given source node in the graph, the algorithm finds the shortest path between that node and every other. It can also be used for finding the shortest paths from a single node to a single destination node by stopping the algorithm once the shortest path to the destination node has been determined[10][11].

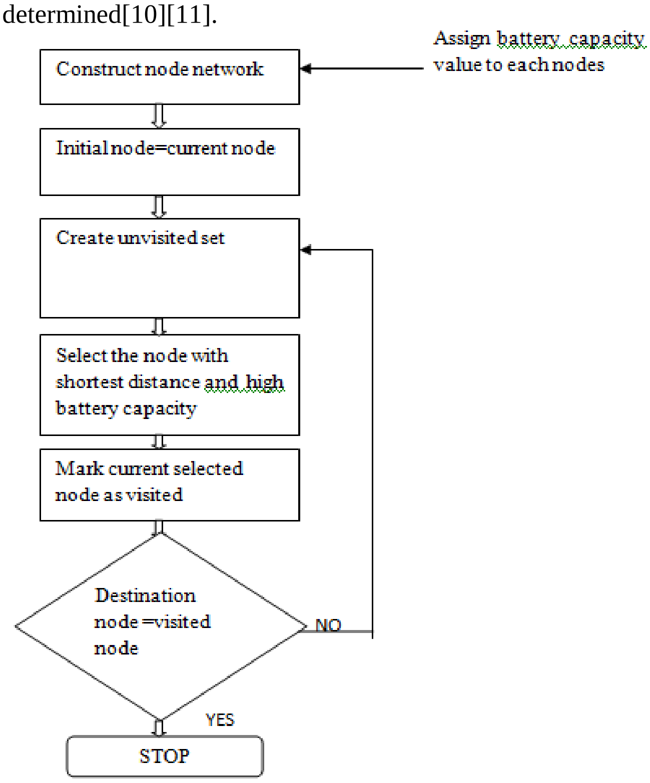

Fig 3: Modified dijkstra's algorithm

Consider a node network with 25 nodes .show all possible routes, assign battery capacity to each node. Set the initial node as current.. Create a set of all the unvisited nodes called the unvisited set. For the current node, consider all of its unvisited neighbors and calculate their tentative distances. Compare the newly calculated tentative distance and battery capacity of those nodes and assign the smaller one with high battery capacity. When we are done considering all of the neighbors of the current node, mark the current node as visited and remove it from the unvisited set. If the destination node has been marked visited then stop. The algorithm has finished. Otherwise, select the unvisited node that is marked with the smallest tentative distance with high battery capacity, set it as the new "current node", and go back to step of creating the unvisited set [7]. Simulations can be done by using different network lifetime and different transmission ranges [1][4].

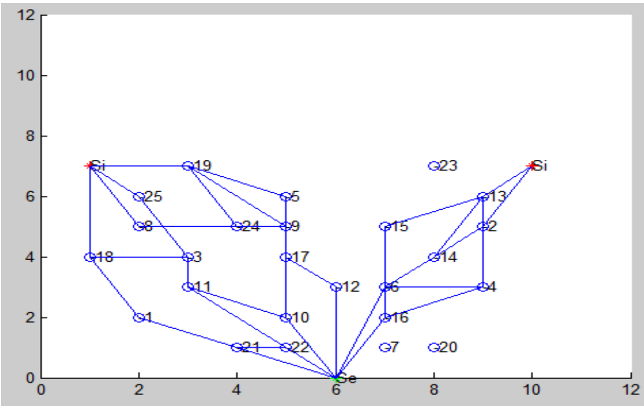

Fig 4: Sink relocation of EASR with modified dijkstra's routing protocol

In the proposed sink relocation method, where EASR along with modified dijkstra's routing protocol is used. It find shortest path from source node to destination node and consider the battery capacity of nodes in WSN. It selects the node with shortest distance and high battery capacity.

VI. Analysis

To investigate the performance of EASR with modified dijkstra's algorithm, several simulations were conducted. The compared methods are EASR-MCP and EASR-MODIFIED DIJKSTRA'S. For this consider a Wireless Sensor Network with 25 nodes and are deployed randomly, then assign battery capacity to each nodes. Network lifetime of WSN is the comparison factor.

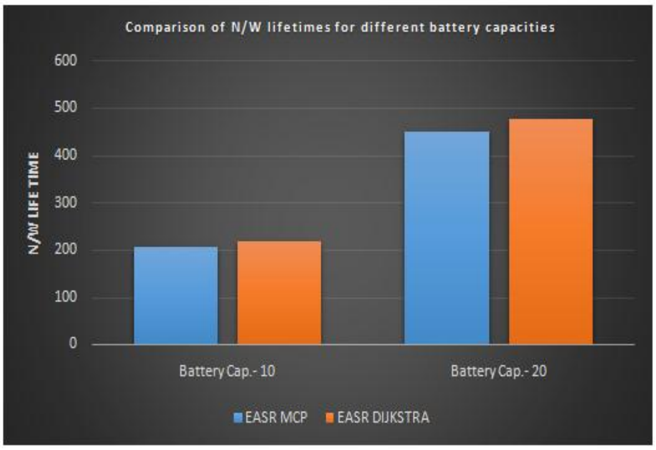

Fig 5 :Network lifetime comparison by varying initial battery energy

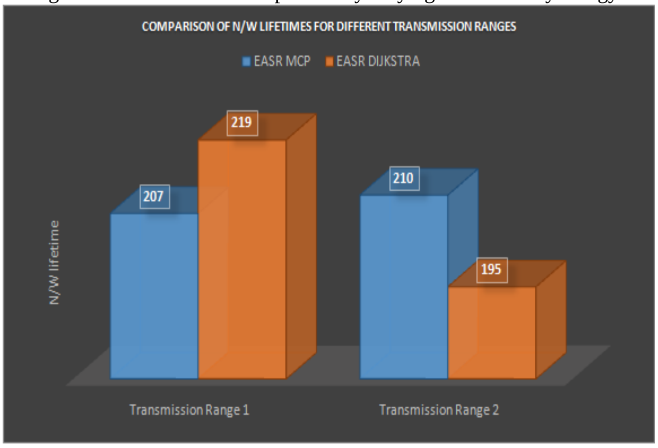

Fig 6 : Network lifetime comparison by varying the transmission range

The two simulation scenarios compared the resulting network lifetime performance of algorithm by varying the battery capacity value and transmission range. In different battery capacities the simulation results shows that as battery capacity increases the network lifetime of EASR-MODIFIED DIJKSTRA'S is high. In the case of different transmission range, at low transmission range it proposed system shows high network lifetime, but the transmission range increased the network lifetime of proposed scheme is little bit less than existing system[10][9].

VII. Conclusion

The network lifetime of Wireless Sensor Network will significantly affected by the depleting speed of battery energy. For prolonging the network life time, researchers design energy aware routing methods to conserve the battery energy. Another approach for prolonging the life time is sink relocation mechanism. To increase the lifetime of nearby sensor nodes of sink, by avoiding staying of sink at a certain location. To enhance the performance of enduring the network lifetime, the proposed scheme incorporates EASR and modified dijkstra's routing protocol. The modified dijkstra's algorithm consider the shortest distance as well as the battery value of each sensor node and select the node with shortest distance and high battery capacity. This new method decreases the depleting speed of battery and thereby increases the network lifetime. Simulation results show the proposed method will increases the network lifetime at different battery values and low transmission range.

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