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Adaptive Boost Network Lifetime Algorithm for WSN

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Abstract:

Wireless sensor network is mostly used in data transmission and communication. So saving the power during data transmission and fast data delivery rate are the main concern in WSN. In this research paper two main algorithms are discussed as how to increase the speed of data transfer and how to decrease the energy while data transfer is taking place. Wireless sensor network is a massive network, where many sensor nodes are present. An algorithm named ABNLA is designed in this paper which follows the property of partial wireless mesh network with spanning tree (ST). Prim's algorithm is applied to find the minimum spanning tree (MST) . This adaptive boost network lifetime algorithm is highly efficient for the fast data transfer and the energy saving.

Keywords **—** WSN, spanning tree, MST, partial wireless mesh topology, prim's algorithm, ABNLA, sensor nodes, energy efficiency, fast data transfer.

1. INTRODUCTION

Wireless sensor networks are defined as low-cost, low-power networks, these networks consist of radio nodes which are equipped with sensing devices. The low-cost equipment provides huge deployments, recompensing for the awfully limited transmission range which are associated with the low transmission power. Wireless sensor networks have a massive amount of applications, ranging from environmental to military domains [1].

Wireless sensor network (WSN) or wireless sensor & actuator network (WSAN) are spatially dispersed sensors to monitor environmental or physical conditions such as humidity, temperature, fire etc. and to cooperatively pass their data through the network to the core location. WSN consist of three main components that are nodes, gateways and the software. The sensors measure the parameter of importance & transmit their data without using wires through the gateway to the host system where the software collects the data, processes can be analysed easily. Increased energy efficiency in transferring the information is enabled by the multi-hop topology of the network. Moreover, additional

important information from other sensors can be aggregated during the process of multi-hop transmission through in-network processing [2].

The development of wireless sensor networks offers the promise of a low cost solution for monitoring important infrastructure for personnel monitoring, traffic monitoring, operations and security monitoring. Wireless Sensor Networks is come out as a new research technology in the distributed computing environment and it plays a very important role in the pervasive computing which help to support various applications. It has a large potential to be utilized in battlefields and in different commercial applications like habitat monitoring, traffic surveillance, construction structures, smart offices, smart homes etc. This new technology is exciting with infinite potential for abundant application areas including environmental, medical, transportation, military, entertainment, crisis management, smart space and homeland defence. At any time every sensor node can obtain its location information from other positioning system and send data to sink. The characteristic of this is to divide Wireless sensor network into network based on Topologies i.e. Bus, Tree, Ring, Star, and Mesh Information of the position of nodes, and those nodes are prepared within the network by the Topological way [3].

The good features of single-time setup based on price were efficiently used in the proposed DEMST (distance energy minimum spanning tree) algorithm

that used an available energy-based MST routing scheme to search for the finest route to the BS. This technique enhanced both the data delivery capability and life time of the network [4]. Spanning trees can be used in various different kind of applications where data has to be collected for e.g. WSN or data has to be distributed (eg. divisible load scheduling) [5]. Here we focus on wireless sensor network (WSN) where the data has to be collected fast and power efficient for boost network lifetime.

I. IDENTIFY THE PROBLEM AND PROPOSED GRAPH

When in defence field wireless sensor network is used where life of sensors and less time delay are very important because the fast information transmission makes a good and fast communication between the soldiers and basically the life of the soldiers is depends on the fast communication. Hence the energy and the time delay are the main resources to manage in wireless sensor network and they have to be managed in such a way that the life of the sensors is extend and the time delay for the duration is minimised for a particular field mission [6]. Thus in this research paper create an algorithm to boost the lifetime of sensor network which is ABNLA (Adaptive Boost Network Lifetime Algorithm) and clear all trouble that are fast data gathering/transmit, efficiency of power, unbreakable exchange data connections and also cost effectiveness with the help of minimum spanning tree and partial wireless mesh network topology apply on proposed undirected graph is showing in figure1. By using the network topology on wireless sensor network because the most important aim of topology management is to save power while maintaining connectivity of network. It is not easy for creating healthy and reliable wireless sensor networks. Prim's algorithm is to find out the minimum spanning tree (MST) with low cost to decrease many problems. Considered network is given below.

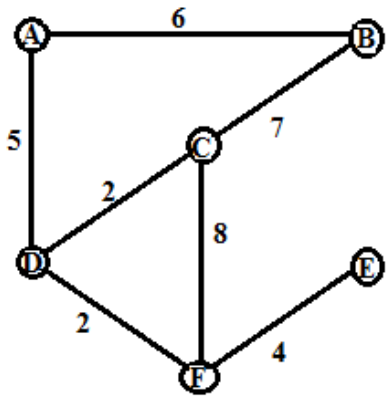

Figure1: proposed undirected graph

II. NETWORK TOPOLOGIES

The development and management of WSN have occupied conventional network topologies in new instructions. Different types of Wireless sensor network topologies are Bus, Star, Tree, Ring and Mesh [7].

Mesh topology introduces the concept of routes in the network. Unlike each of the previous topologies, while sending the messages on a mesh network can take any of numerous possible paths from source to destination. (Remind that even in a ring; although two cable paths are present, messages can only travel in one direction.) Some WSNs, most remarkably the Internet, make use of mesh routing. A mesh network in which every device connects to every other is known as a full mesh. As shown below, partial mesh networks also exist in which some devices connect only indirectly to others [8].

These topologies are defining by its diagrams which are showing in figure2 below.

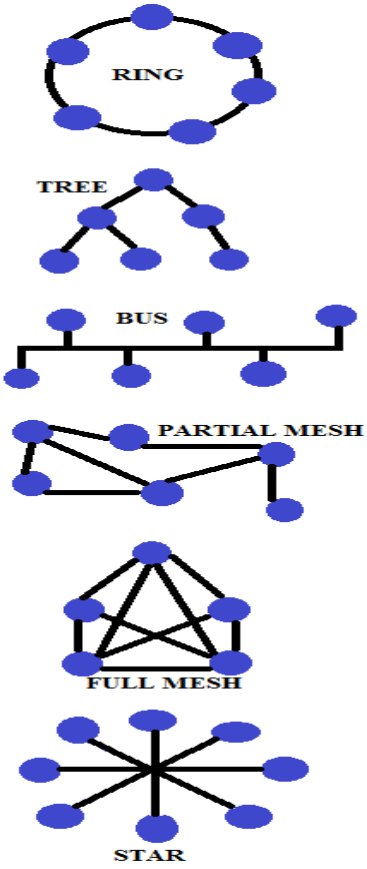

Figure2: Network Topologies

There are basically the two types of wireless mesh network topologies first is fully wireless mesh network and second is partially wireless mesh network.

Fully wireless mesh network are generally multi-hoping system in which all sensor nodes can transfer the information or communicate with central node as well as with each other. The circulation of data through mesh allows a sensor network to enlarge, in other words the range is extended unlimited. Sensor network is extremely fault-tolerance as each sensor nodes have to many paths back to the central node and other nodes. If any node causes corrupted, then the network automatically regenerates itself around the failed node. The major issues are not related to latency and power but the main issue is to expand the network. Hence, Mesh topology is suitable for energy management that transmits temperature to a controller to establish the energy usage [9].

Partially wireless mesh network is more practical as compare to fully wireless mesh network topology. Here, some of the systems are connected in similar way as in wireless mesh network topology while rest of the sensor nodes are only connected to one and two sensor nodes as shown in figure2 also. In this research partial wireless mesh network topology is used because considered graph is following the property of partial mesh topology. It can be said that in the partial mesh network the source node are indirectly connected to other sensor nodes. This network is less costly and reduces redundancy.

Overall in wireless mesh topology network the data can be transmitted from different sensors concurrently. This topology can endure high traffic. Even if one of the mechanisms fails there is always an alternative present. So the transferring of data doesn't get affected. Extension and modification in wireless mesh topology can be done without disturbing other nodes.

III. DESCRIBE THE SPANNING TREE

A spanning tree of a graph is just a sub graph that contains all the nodes and a tree. A graph can have many spanning trees. It can also assign a weight to each edge, which is a number of showing how critical it is, and use this to assign a weight to a ST by computing the sum of the weights of the edges in that ST. There are maximum possible spanning trees of proposed graph in this research paper are showing in figure3.

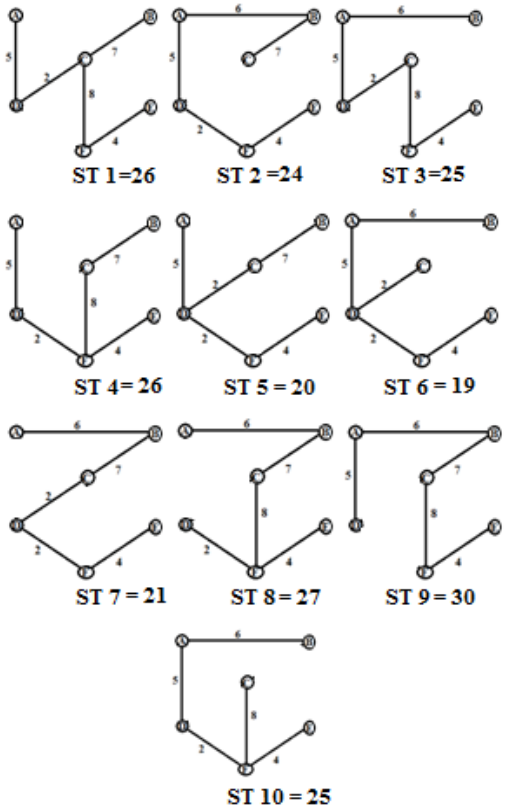

Figure3: spanning tree of proposed graph with its cost

A minimum spanning tree and a minimum weight spanning tree it might be possible that the weight of the minimum weight of ST is equal to the weight of the MST. More usually, any undirected network has a minimum spanning tree [10].

In other words, a minimum spanning tree is a tree formed from a division of the edges in a given undirected network, with two properties one is it spans the network, i.e., it includes every nodes in the network, and secondly it is a minimum, i.e., the total weight of all the edges is as small as possible [11].

To describe that how to find out a minimum spanning tree, there are two algorithms prim's algorithm and kruskal's algorithm. Both algorithms differ in their style, but both ultimately end up with the MST [12]. Kruskal's algorithm is uses edges, and prim's algorithm is uses vertex/nodes links in determining the MST [13]. Both prim's algorithm and kruskal's algorithm are greedy algorithms that run in polynomial time [14].

In this research paper using prim's algorithm to determine a minimum spanning tree.

IV. ADAPTIVE BOOST NETWORK LIFETIME ALGORITHM

In this paper, design of an adaptive boost network lifetime algorithm for overcomes all problems of wireless sensor network. This algorithm is showing that the minimised cost of network with the help of MST as compare to the other spanning trees, so the data transfer rate is fast. Also use the mesh network topology which one is very effective to saving the energy of network and also create healthy network connectivity in each node. The steps of this algorithm are as follows:

Step1: initially consider an undirected wireless sensor network graph.
Step2: identify to design a network topology.
Step3: If
{
This topology is following the property of partial wireless mesh network, then carry on to next step.
}
Else
{
Stop
}
Step4: find out the all spanning trees of proposed graph.
Step5: calculate the cost of all spanning trees.
Step6: now applying the prim's algorithm to proposed graph.
Step7: find out the minimum spanning tree (MST).
Step8: calculate the cost of MST.
Step9: compare the spanning tree and MST.
Step10: End of this algorithm.

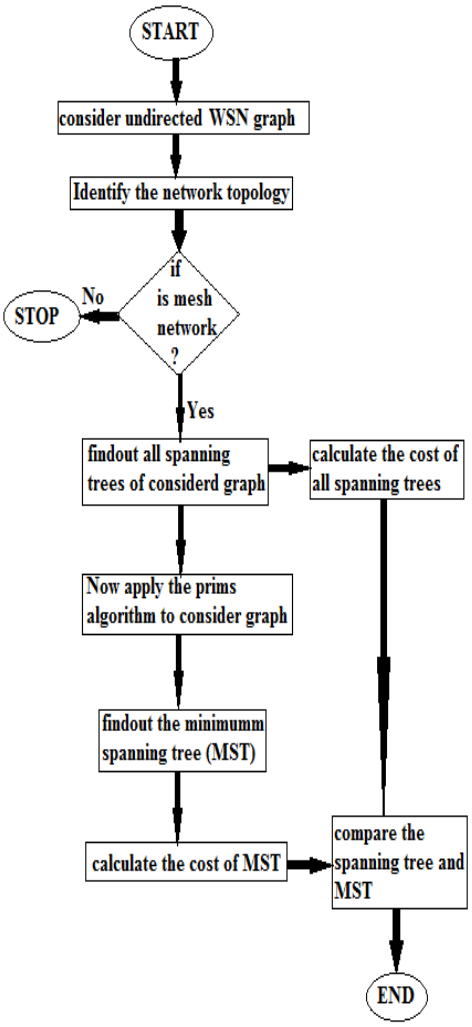

Figure4: Flowchart of Adaptive Boost Network Lifetime Algorithm

V. APPLY PRIM'S ALGORITHM ON PROPOSED GRAPH

Apply prim's algorithm on proposed graph is showing step-by-step in figure5. When starting with node "A" from proposed graph the following steps of algorithm are:

Step0: S= {A}
NODE\S= {B, C, D, E, F}
LIGHTEST WEIGHT= {A, D}

Step1: S= {A, D}
NODE\S= {B, C, E, F}
A= {A, D}
LIGHTEST WEIGHT= {D, C}, {D, F}

Step2: S= {A, D, C}
NODE\S= {B, E, F}
A= {{A, D}, {D, C}}
LIGHTEST WEIGHT= {D, F}

Step3: S= {A, D, C, F}
NODE\S= {B, E}
A= {{A, D}, {D, C}, {D, F}}
LIGHTEST WEIGHT= {F, E}

Step4: S= {A, D, C, F, E}
NODE\S= {B}
A= {{A, D}, {D, C}, {D, F}, {F, E}}
LIGHTEST WEIGHT= {A, B}

Step5: S= {A, B, C, D, E, F}
NODE\S= { }
A= {{A, D}, {D, C}, {D, F}, {F, E}, {A, B}}

COMPLETED MST WITH MINIMUM COST= 19

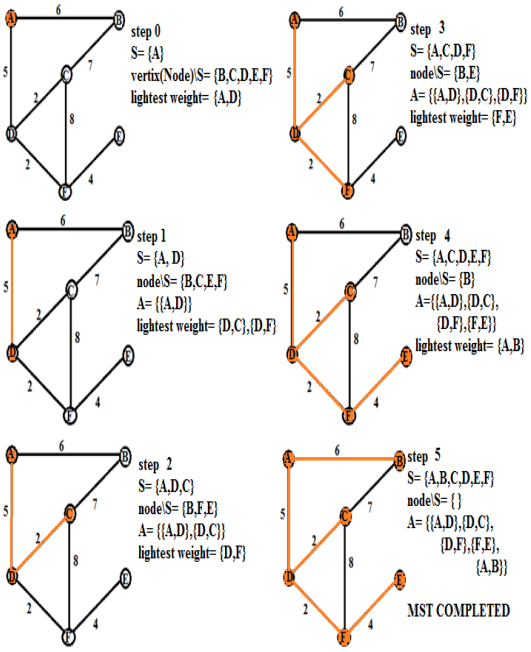

Figure5: steps of prim's algorithm

The main design of prim's algorithm is alike to that of dijkstra's algorithm for finding shortest path in a graph. Prim's algorithm has the property that the edges in the set A always from a single tree always consider a minimum weight edge from a particular node and draw a minimum spanning tree steps-by-step from that node as showing in figure5. After finding a minimum spanning tree, calculate its minimum cost which is 19.

VI. ANALYSIS AND RESULTS

There are maximum possible spanning trees of proposed graph and its cost is depending on energy using in any spanning tree. The analysis graph is showing each spanning tree cost and energy usage in figure 6 is given below.

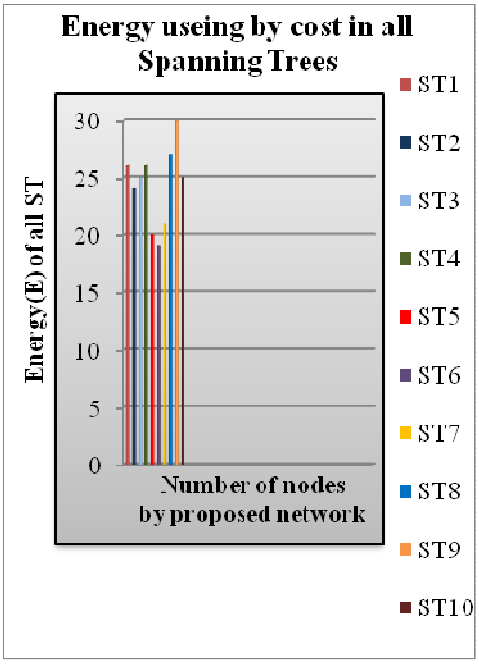

Figure6: energy using by cost in all spanning trees

The energy level use in graph according to the cost of spanning tree such as ST1= 26, ST2= 24, ST3= 25, ST4= 26, ST5= 20, ST6= 19, ST7= 21, ST8= 27, ST9= 30 and ST10= 25 as showing in figure6.

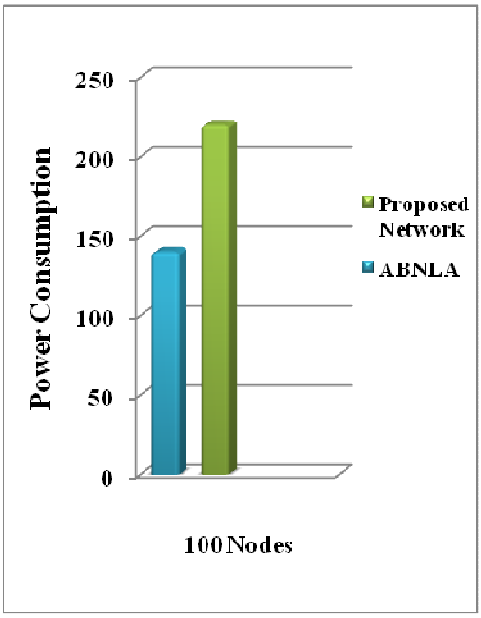

Figure7: Power consumptions between proposed network and design ABNLA algorithm

In this research paper, proposed a wireless sensor network, on this network with the help of partial mesh network topology and minimum spanning tree (MST), design an adaptive boost network lifetime algorithm (ABNLA). This algorithm is very helpful to maintain high speed data transaction and also it is a power efficient algorithm. The power consumption between ABNLA algorithm and proposed network is showing in figure7.

Also the energy utilize performed for different networks which is used in this paper that is spanning tree (ST), minimum spanning tree (MST), normal proposed network, partial mesh network and designed algorithm ABNLA algorithm is showing in figure8 which is given below.

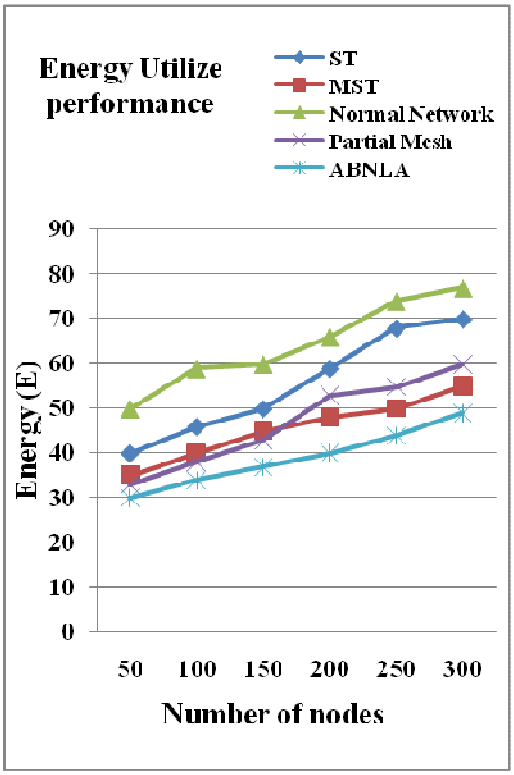

Figure8: Energy saving performance for different networks with number of nodes between "50-300"

Hence the energy utilize with ABNLA algorithm is very low so it is better than compare to others.

On other hand the speed of information transferring is also increase by applying adaptive boost network lifetime algorithm. The minimum spanning tree is creating a best path from every node to transferring data quickly. The properties of partial mesh network are unbreakable conversation, fast data transfer and also power efficiency.

While merging both technologies to design ABNLA algorithm which is more reliable, faster and boost network lifetime as compare to other. The fast transmission speed performance occur which is showing in figure9 is given below.

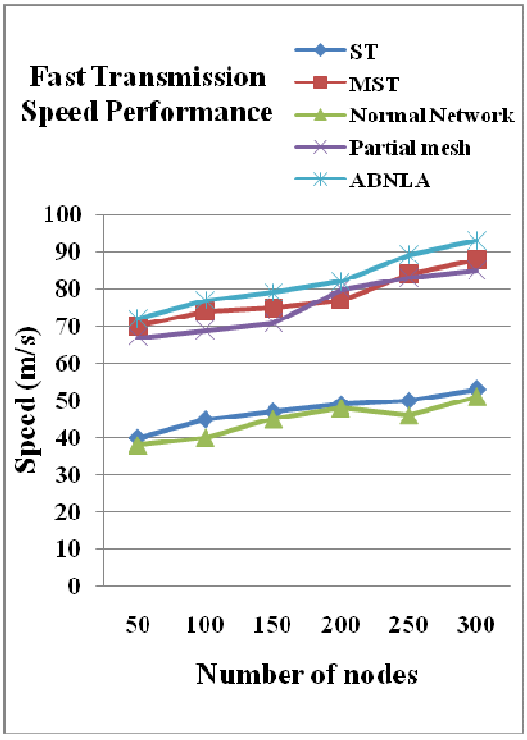

Figure9: graph showing fast data transmission for different networks with number of nodes between "50-300"

VII. CONCLUSION and FUTURE SCOPE

The partial wireless mesh network is reducing the power consumption while transferring the information as compare to other. After that the minimum spanning tree by the prim's algorithm is also saving the energy and the delivery of data packets is being very fast as compare to other techniques.

In future prim's can be applied on other topologies or in mesh topology other MST techniques can be applied for better result.

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