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FACILITATING EFFICIENT ROUTING USING PROTRACTED BICLUSTERING PROTOCOL FOR WIRELESS SENSOR NETWORKS (PBP_WSN)

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ABSTRACT
Wireless Sensor Networks (WSN) are spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure. Routing algorithms play a crucial role in WSN sensors lifetime. This paper proposes a novel efficient routing algorithm Protracted Bi-clustering Protocol for Wireless Sensor Networks (PBP_WSN) which uses the bi-cluster based approach for getting prolonged lifetime of the sensor nodes. This algorithm works in two fold where the sensor nodes are clustered using heuristics and then bi-clustering (parent and child hierarchy). Results are promising which considerably improves the lifetime of the sensor nodes and cluster heads.

KEYWORDS: Wireless Sensor Networks, Bi-clustering Protocol, Sensor nodes, Cluster heads, Lifetime.

I. INTRODUCTION
Wireless sensor networks (WSN), called wireless sensor and actuator networks (WSAN), are spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on [1].

A routing algorithm is a set of step-by-step operations used to direct Internet traffic efficiently. When a packet of data leaves its source, there are many different paths it can take to its destination [2]. One of the typical applications in this network, gathering and sending sensed data to the base station [3]. The main constraint of sensor nodes is their very finite battery energy, while limiting the lifetime. For this reason, the protocol running on sensor networks must efficiently reduce the node energy consumed in order to achieve a longer network lifetime [3]. Data gathering (collecting the sensed information from the sensor nodes and routing the sensed information) has to be done in an energy efficient way to ensure good lifetime for the network. Hence, data gathering protocols play an important role in wireless sensor networks keeping in view of severe power constraints of the sensor node [1]. Therefore, a major part of the research work concentrates on extending life time of networks by designing energy efficient protocols, which is the core of this paper.

II. WSN NETWORK TOPOLOGIES AND SIGNIFICANT FEATURES
WSN nodes are typically organized in one of three types of network topologies. In a star topology, each node connects directly to a gateway. In a cluster tree network, each node connects to a node higher in the tree and then to the gateway, and data is routed from the lowest node on the tree to the gateway. Finally, to offer increased reliability, mesh networks feature nodes that can connect to multiple nodes in the system and pass data through the most reliable path available. This mesh link is often referred to as a router (see Figure 3).

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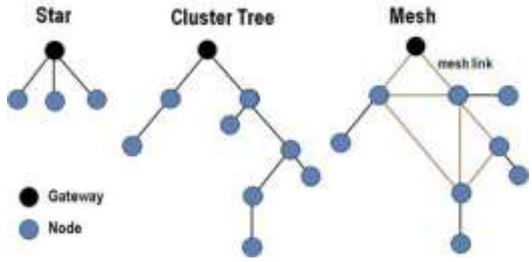

Figure 1. Common WSN Network Topologies

A WSN node contains several technical components. These include the radio, battery, microcontroller, analog circuit, and sensor interface. When using WSN radio technology, you must make important trade-offs. In battery-powered systems, higher radio data rates and more frequent radio use consume more power. Often three years of battery life is a requirement, so many of the WSN systems today are based on ZigBee due to its low-power consumption. Because battery life and power management technology are constantly evolving and because of the available IEEE 802.11 bandwidth, Wi-Fi is an interesting technology.

The second technology consideration for WSN systems is the battery. In addition to long life requirements, you must consider the size and weight of batteries as well as international standards for shipping batteries and battery availability. The low cost and wide availability of carbon zinc and alkaline batteries make them a common choice

To extend battery life, a WSN node periodically wakes up and transmits data by powering on the radio and then powering it back off to conserve energy. WSN radio technology must efficiently transmit a signal and allow the system to go back to sleep with minimal power use. This means the processor involved must also be able to wake, power up, and return to sleep mode efficiently. Microprocessor trends for WSNs include reducing power consumption while maintaining or increasing processor speed. Much like your radio choice, the power consumption and processing speed trade-off is a key concern when selecting a processor for WSNs. This makes the x86 architecture a difficult option for battery-powered devices.

The main characteristics of a WSN include:

- Power consumption constraints for nodes using batteries or energy harvesting
- Ability to cope with node failures (resilience)
- Some mobility of nodes (for highly mobile nodes see MWSNs)
- Heterogeneity of nodes
- Scalability to large scale of deployment
- Ability to withstand harsh environmental conditions
- Ease of use and Cross-layer design

III. ROUTING PROTOCOLS IN WSN

In WSN, collection of sensor nodes into a cluster is well-known as clustering. Every cluster contains a leader called cluster head. A cluster head may be selected by the group of cluster. A cluster head collects the information from the nodes within cluster and send this information to the base station (destination). The clustering procedure in WSNs is shown in figure 2. Clustering can be used as an energy efficient communication protocol.

The main aim of clustering is to minimize the total transmission power aggregated over the nodes in the selected path, and to balance the load between the nodes for extend the network lifetime. Cluster-based routing algorithms are growing to be an essential part of routing technology in wireless sensor networks on account of a form of advantages, such as larger scalability, less load, a smaller amount energy consumption and extra robustness [4].

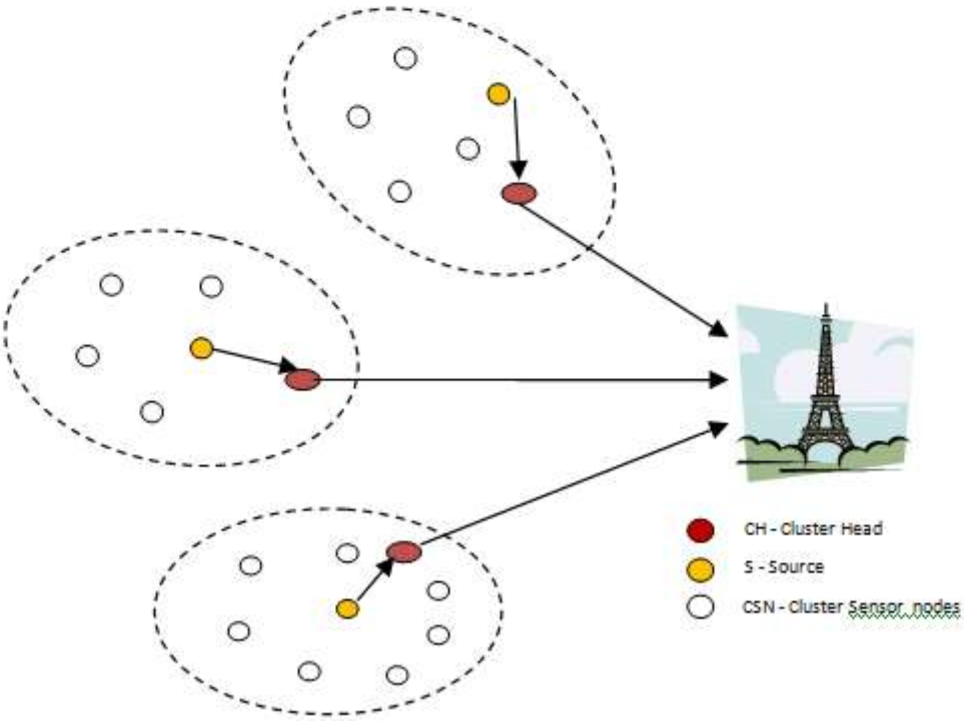

Figure 2. Cluster based routing in WSN

S.No	Algorithm	Merits	Demerits
1	TEEN	Deployed for time critical applications Responds well in sensitive situations to handle attributes such as temperature	It is threshold sensitive and doesn't responds when node not communicated if a node dies network is not able to locate it
2	LEACH	Performs well in energy consumption It use TDMA and use cluster heads for unnecessary collision	Energy efficiency is not up to the mark It doesn't performs well in large networks Scalability is poor
3	LEACH-VF	It use overlapped sensing coverage strategy It performs hole sensing well	Energy efficiency is not up to the mark Scalability is poor

IV. PROPOSED SYSTEM: PBP_WSN Algorithm

The PBP_WSN algorithm works with a two-fold strategy which helps the route table to keep update the changes in node state. In first fold the nodes will be clustered based on the neighbor details. In second fold the cluster head will be calculated and based on that the bi-clustering of the parent and child node will be carried out. PBP_{CH} is the clusters head selection formula:

$$PBP_{CH} = \frac{RS_x}{\sum Links\ connecting\ to\ x\ (RQ_y + \alpha)} - \frac{RS_x}{\sum Links\ connecting\ to\ x\ (Dist(x)^2 + \beta + \alpha)}$$

Where RS_x refers the residual energy of node x and RQ_y refers the required energy for sending 1 bit from node x to y, α is the number of bits to be sent from node x to y, $Dist(x)$ is the distance from node x to node y, β is the transfer power for 1 bit.

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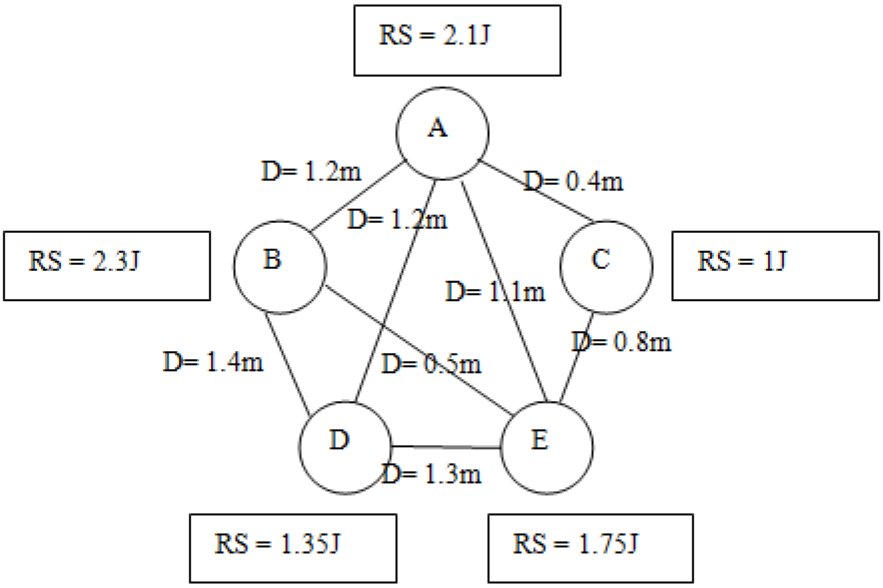

Figure 3. WSN sample scenario

Sample Cluster Head values calculation for Network portrayed in Figure 3 will be as follows.

$$PBP_{CH(A)} = \frac{2.1j}{1.2^2 + 1.2^2+1.1^2+0.4^2} = 0.4941$$

$$PBP_{CH(B)} = \frac{2.3j}{1.2^2 + 1.2^2+0.5^2+1.4^2} = 0.4518$$

$$PBP_{CH(C)} = \frac{1j}{0.8^2+0.4^2} = 1.25$$

$$PBP_{CH(D)} = \frac{1.35j}{1.3^2 + 1.4^2+0.5^2} = 0.3461$$

$$PBP_{CH(E)} = \frac{1.75j}{1.3^2 + 0.5^2+1.1^2+0.8^2} = 0.4617$$

The algorithm for the PBP_WSN is explained as follows:

Algorithm : PBP_WSN
for all nodes
do
{
Status = Ready
Broadcast RS_Alert to all neighbor nodes
Receive RS_Alert from all neighbor nodes
Compute distance from all neighborhood
Update neighborhood table
Function Compute_BiClus_Head
{
if Clus_Head > all neighborhood Final_Clus_Head = Clus_Head
Status = Cluster Head
else

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{
Status = Cluster Member
if (node exist in more than one cluster head range)
Node joins to closer cluster head
}
}
Function Compute_Parent _Cluster
{
if (Parent _Cluster > all neighborhood) then Parent_clus = Parent _Cluster
Status=Parent Node
else
Status=Child Node
Parent _Cluster broadcast TDMA to Child node
}
}
End do

Thus the algorithm works in two fold which initially creates a cluster and then subsequently cluster head creation is performed which leads to the parent and child node formation.

V. RESULTS

The PBP_WSN protocol is implemented in MATLAB. The simulation environment contains N nodes randomly dispersed in 100x100 square fields with single base station. Node numbers may range from 100 to 500, cluster radius may be up to 40m, sensing radius may be upto 20 m and sink position is set to (50,150). The simulated result is presented in the figures

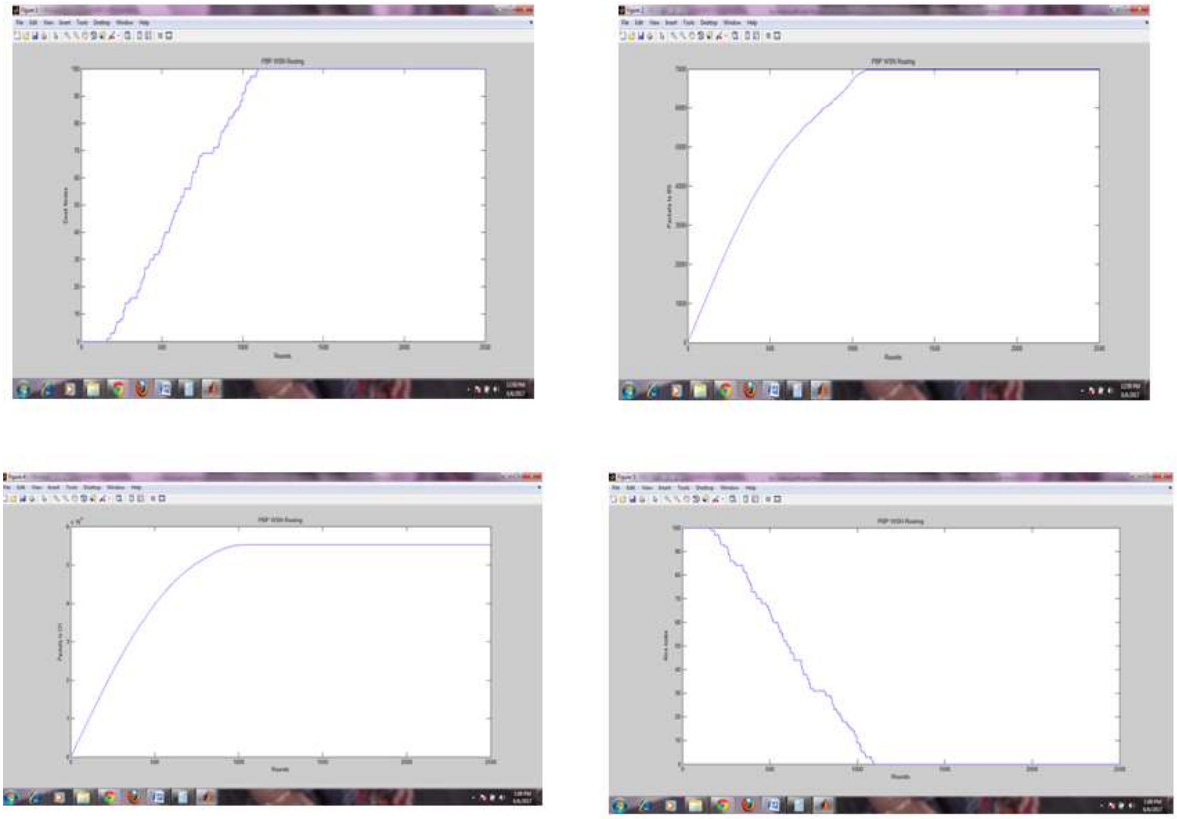

Figure 4:PBP_WSN Simulated Results

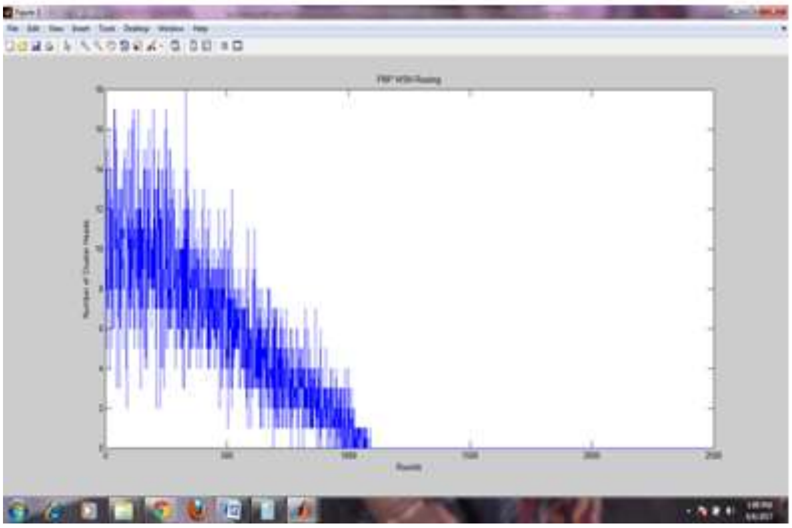

Figure 5. Number Of Cluster Heads Vs Rounds

VI. CONCLUSION

In this paper, protracted bi-clustering based based protocol is proposed for the wireless sensor networks. It improves the efficiency of the energy consumption along with the improvement of the node lifetime values. The bi-clustering strategy helps in improving the dynamic updation of the routing table which may overcome the problem of the dead node sensing and cluster head value updating

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