

Position Responsive Routing Protocol (PRRP)

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Abstract— *Wireless Sensor Networks (WSNs) has very foremost role with all sensing applications, and also have a wide range of easily deployable applications under any circumstances. That's why it is gaining more attention of researchers every day. WSN is resource constraint type of network, without having battery recharging facility. Routing or path finding for data transfer is the main energy consuming operation of sensor networks, a good number of routing and Mac-Layer protocols has been already designed to enhance its energy efficiency. We try to propose a new Position Responsive Routing Protocol (PRRP) by using Global Positioning Systems (GPS) approach for enhancing energy efficiency of wireless sensor network, under certain controlled conditions. Our research discusses various existing WSN routing protocols and propose a new routing protocol with Position Responsive (PR) approach. Research results shows a 23% to 25% significant improvement in overall efficiency of WSN.*

Keywords— WSN, Energy efficient, PRRP position responsive routing protocol, GPS, Routing protocol,

I. INTRODUCTION

WSN is a wireless network consisting of small nodes with limited sensing, computation, and wireless communications capabilities [1]. Each sensor collects data from the monitored area (such as temperature, sound, vibration, pressure, motion or pollutants). Then it routs data back to the base station BS [2]. Data transmission is usually a multi- hop, from node to node toward the base station. Sensor nodes are equipped with small, often irreplaceable batteries with limited power capacity. An important concern is the network lifetime: as nodes run out of power, the connectivity decreases and the network can finally be partitioned and become dysfunctional [3],[4],[5]. Routing in WSNs is a very challenging issue due to the inherent characteristics which differentiate such networks from other wireless networks such as ad hoc networks and cellular networks [3],[6],[7]. In recent years, many algorithms have been proposed for the routing issue in WSNs. The minimum energy routing problem has been addressed in ([7]–[13]). The minimum total energy routing approaches in these papers are to minimize the total consumed energy. Instead of trying to minimize the total consumed energy on the path, the objective is to maintain the connected network as long as possible. If sensor nodes consume energy more equitably, they continue to provide connectivity for longer, and the

network lifetime increases. [4], [10], [11], [12], [13],[17], [18].

As sensor networks have specific requirements on energy saving, data-oriented communication, and inter-connection between non-IP and IP, therefore sensor network-dedicated routing protocols may be required, for Energy efficient routing scheme.

II. PROBLEM STATEMENT

Routing in WSNs have a primary task for transfer of data from source (sensor node) to the sink, in case data is available for transfer in resulting of any physical event occur or time driven query run at the sensor node. Initially routs defined by the nodes then nodes become able to send or receive the data by using those routing paths.

A. Related Work & Problem Statement

An ample number of different routing protocols had been designed by the researchers, On the basis of topologies routing protocols may lays on following types.

1. Flat routing Protocols
2. Hierarchal routing Protocols
3. Location based routing Protocols

Among all topologies based routing protocols, hierarchal routing protocol technique is more popular regarding the power saving of sensor nodes. This technique works on the formation of several clusters (a sub network within network). Cluster is responsible to transfer data from node to the sink, while direct data sending approach from each node is not supported with this method. Clusters communication works on the basis of cluster head. Communication with sink can be done with the help of cluster head; they collect data from neighboring nodes and send it to another cluster head, which is responsible for any other cluster, this mechanism continuous until the data reaches to the sink. The current energy efficient routing protocols including LEACH and HEED is also designed on the basis of clustering. The main issue with this method is cluster heads normally remain active for more time than other nodes in the cluster and resulting they lose their energy before other nodes. Another important concern is

that it is hard to maintain the energy level of all sensor nodes at same level, and if cluster head loose it energy first then in that case, it is possible that we might lose one segment of network from our main network topology. Even though those routing protocols works fine up to a limited size of sensor network, but they are not suitable for large amount of networks, as they broadcast the message to find out their neighbors and also to form new clusters by finding new cluster heads. In this process they lose an ample amount of energy, and even assumptions which they made or not possible normally in real, such as LEACH assumes that all nodes are homogenous and equal in power while it is not in actual.

Hence it is highly needed to design an energy efficient routing protocol with assumptions closer to the real, we are position responsive routing protocol (PRRP) WSN routing protocol which is more energy efficient than the existing protocols.

B. Network Model

Our assumptions for sensor network are such that, sensor nodes are randomly distributed over an area of 80 x 80 meters with following network properties.

1. Network is static and nodes are distributed in random format, while area is divided in equal square grid format.
2. There is exists only one base station, which is deployed at a fixed place outside.
3. The energy of sensor nodes cannot be recharged.
4. Sensor nodes are location aware, with the help of GPS.
5. The radio power can be controlled, i.e., a node can vary its transmission power.

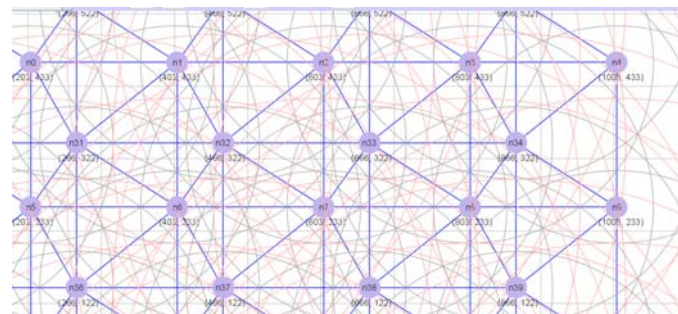
Above all assumption are on wide scope, assumption no. 5, is becoming the cause of energy saving, as nodes will be aware about their location and sink too, hence the amount of energy which normally network always use to find out the initial location will be saved.

III. SIMULATIONS & RESULTS

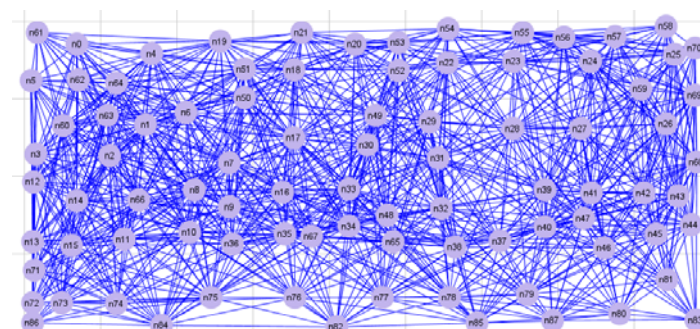
A. Tested Topologies and Scenarios

The entire simulation tests were conducted by using a very well known simulator by the research community NS2, by applying different topologies and approaches. The few of those topologies are shown below. In the entire topologies sensor nodes were distributed within a area of 80*80 meters and then tested their routing capabilities in two ways, initially it was tested with a normal distribution, while in second phase it was tested through position responsive (PR) Algorithm, in which each node was aware about its neighbors' location. The second approach for the routing was tested more excellent in terms of its power saving or in

terms of nodes life optimization, which we discussed with coming section of results with the help of simulation graph figures. The few scenarios screen shots are shown in Figure 1 (A, B)



A. Topology



B. Topology

Figure 1(A,B). Sensor nodes distributed with different topology

IV. SIMULATION

Simulations has been done with the help of worldwide well known and most acceptable NS2 simulator, NS2 is a discrete event simulator targeted at networking research NS2 is an object-oriented, discrete event driven network simulator developed at UC Berkely written in C++ and OTcl (Tcl script language with Object-oriented extensions). It implements network protocols such as TCP and UDP, traffic source behavior such as FTP, Telnet, Web, CBR and VBR, router queue management mechanism such as Drop Tail, RED and CBQ, routing algorithms such as Dijkstra, and more. NS also implements multicasting and some of the MAC layer protocols for LAN simulations. NS-2 includes a tool for viewing the simulation results, called NAM. NAM is a Tcl/Tk based animation tool for viewing network simulation traces and real world packet trace data. The first step to use NAM is to produce the trace file. The trace file should contain topology information, e.g., nodes, links, as well as packet traces. Usually, the trace file is generated by NS. During an ns simulation, user can produce topology configurations, layout information, and packet traces using tracing events in ns. When the trace file is generated, it is ready to be animated by NAM. Upon startup, NAM will read the trace file, create topology, pop up a window, do layout if necessary, then pause at the time of the first packet in the trace file. Through its user interface, NAM provides

control over many aspects of animation. This simulation tool has worldwide acceptability with very high acceptance rate of result.

A. Simulation Parameters

Standard Simulation parameters are shown in Figure 2 below.

Channel type	Channel/WirelessChannel
Propagation model	Propagation/TwoRayGround
Phy type	Phy/WirelessPhy
Mac protocol type	Mac/802_11
Queue type	Queue/DropTail/PriQueue
Link layer type	LL
Antenna type	Antenna/OmniAntenna
Max packet in queue	50
Routing protocol	DSDV
Agent trace	ON
Router trace	ON
Mac trace	ON
Movement trace	ON

Gt_	1
Gr_	1
L_	1.0
freq_	2.472e9
bandwidth_	11 Mb
Pt_	0.031622777
CPThresh_	10.0
CSThresh_	5.011872e-12
RXThresh_	5.82587e-09
dataRate_	11 Mb
basicRate_	1 Mb

Figure 2. Simulation Parameters

As mentioned earlier, the entire simulations were done using NS2 simulator, hence a screenshot of the NS2 simulator during simulation shown in Figure 3. Screen shot show the animated tool NAM, which is commonly used for NS2 simulator for showing graphical simulations and helping to generate trace files. NAM is a graphical interface in which simulation controlling events are available during the active session of wireless simulation. such as, to stop run, fast forward or slow motion available as under,

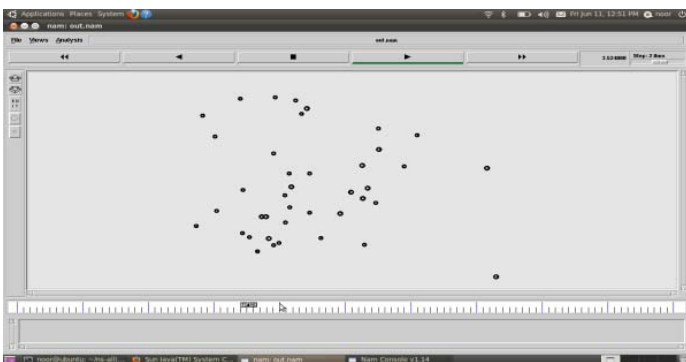


Figure 3: Screen shot of NS2 simulation for wireless sensor network

B. Results with Graphs

WSN Routing Data before PRRP

Figures ranging from 4 to 6 are actually plotted between two parameter such as, with Figure 4, X-axis for time while Y-axis for cumulative energy level for sensor nodes. Three different cases were taken in account with initial assumption that nodes are not aware about their location and are scattered in random fashion over an area of 80 x 80 meter. Case number one (Figure 4) is showing the comparison between time and energy level for routing before it goes for hoping, while with second case (Figure 5) is showing the comparison for routing data between time and energy level but after few number of hopes. In case three Figure 6) is also showing the comparison for routing data but after a maximum number of network hops. All graphs showing the clear understanding about the net results of the simulated routing and sensor nodes energy. Graph 1 show that almost 50 nodes means 100% nodes were alive when the process started and all nodes were drain their energy almost within 40 second of active operation. In the same fashion the different results were shown with different comparison including with Figure 5 and 6.

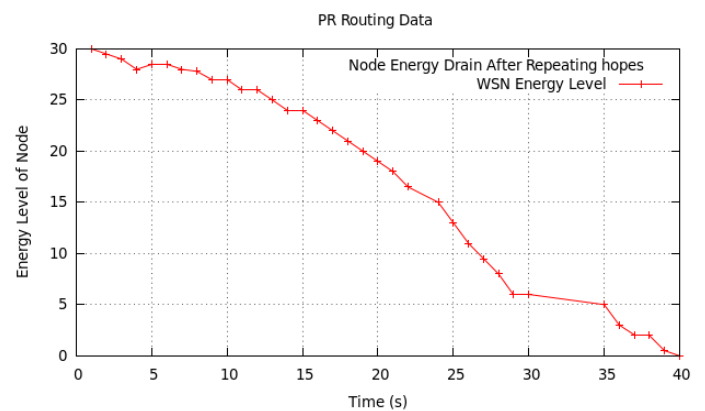


Figure 4. WSN Nodes Energy Drain

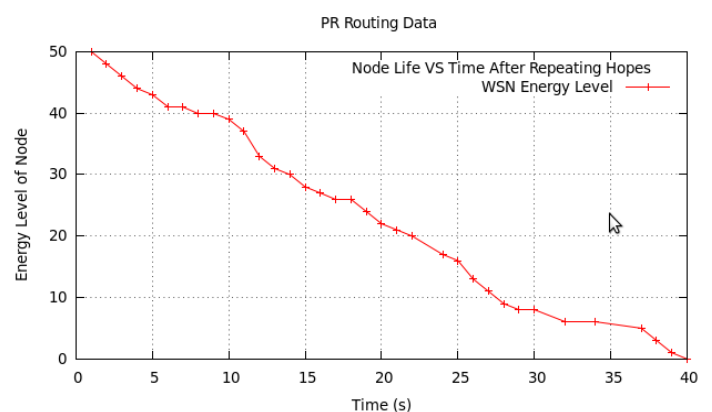


Figure 5. WSN Nodes Life VS Time

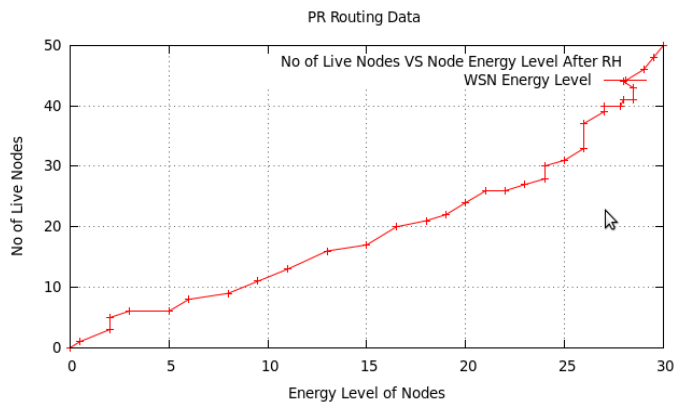


Figure 6. No of live Nodes VS Energy Consumption

Figure 7 shows the result for entire energy loss process for all hopes with the help of different colors, it shows that during the initial hopes the energy level of the nodes were sufficient enough and it was shown with blue color. However when the numbers of hopes were going to be increased the energy level also drastically going down as shown with different graph bar colors, which are indicated in light blue then yellow and finally towards red, which is the last level of energy and almost total energy level were lost at this stage.

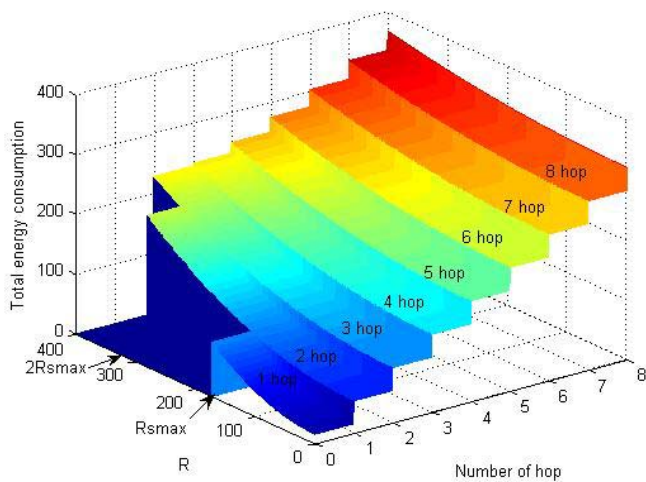


Figure 7. Number of Hopes VS Energy Consumption

WSN Routing Data After PRRP

Figure ranging from 8 to 10 is actually again plotted between two parameter such as graph X-axis for time while Y-axis for cumulative energy level for sensor nodes. Again three different cases were taken in account with assumption that nodes and sink are aware about their location and are scattered in random fashion over an area of (80 x 80) meter. Case number one (Figure 8) is showing the comparison between time and energy level for routing with

multiple hopes, while with second (Figure 9) case it is showing the comparison for routing data between time and no of live nodes energy after few number of hopes. With third case (Figure 10) is also showing the comparison between live nodes and there energy consumption for routing data after few no of hopes. Following graphs shows the clear understanding about the net results of the simulated routing and sensor nodes energy. The result shown in the Figure ranges from (8 to 10), is totally different than the figure ranges from (4 to 6), as with later cases we consider the Position responsive routing algorithm in which we consider that all the neighbor nodes are already aware about their neighbor nodes location with the help of GPS system, in this way each node save his energy level as there is no need to send the initial data packets to the neighbor to find out the sink. In this way initial process for finding sink for multiple times eliminated and resulting node life enhanced approximately from 10 to 12 seconds and during this life enhancement period the network also enable to work for more data transfer and remain live for more time period. This technique increases the time span of sensor network operation which optimized its energy usage and enhances its efficiency.

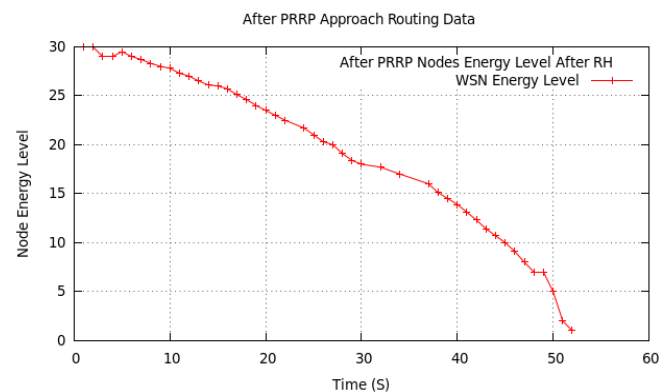


Figure 8. After PRRP Nodes Energy Drain

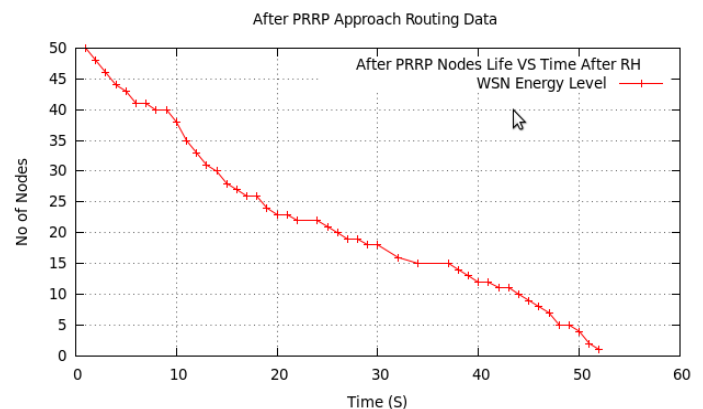


Figure 9. After PRRP Nodes Life VS Time

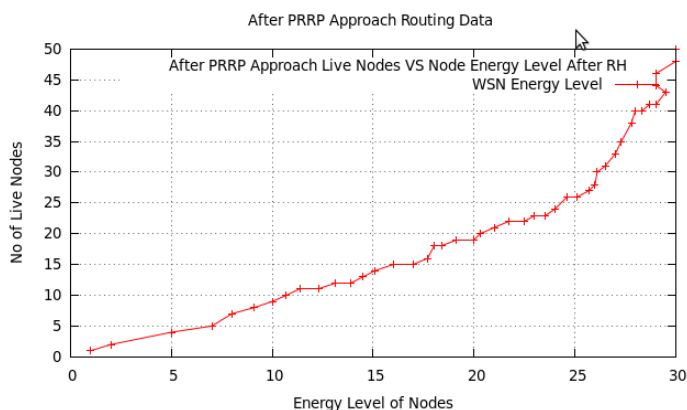


Figure 10. After PRRP Live Nodes VS Energy Consumption

V. CONCLUSION

Wireless sensor network has important role and use, due to its diversify approach and range of applications. WSN is the only most suitable and easy way of deployment in remote and hard areas. But it is an energy constraint type of network without having support to recharge its battery, mainly researchers are paying their attention to optimize its energy level. Routing is the main expensive operation for nodes energy consumption, already a number of different routing protocols has been designed for this purpose. We proposed a new position responsive routing protocol (PRRP), with the help of GPS system to enhance its energy level under certain controlled conditions. Our simulation based research results shows a 23% to 25% significant improvement in WSNs overall energy efficiency level through our proposed new position responsive routing protocol (PRRP).

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