Performance Analysis of ZRP and QHCR in Wireless Sensor Networks

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Abstract- **A Wireless sensor network (WSN) has important applications such as remote conservation monitoring and object tracking. These sensors are equipped with wireless interfaces with which they can communicate with one another to form a network and these sensors that are smaller in size and smart. As sensor nodes are generally battery-powered devices, the critical aspects to face concern how to reduce the energy consumption of nodes, so that the network lifetime can be improved to reasonable times. In approach first, describe the power consumption for components of a typical sensor node, and discuss the main directions to power management methods in wireless sensor networks. Our main goal of Power management in wireless networks which deals with the process of managing energy resources by means of cluster head selection, adjusting the transmission power, and dedicated paths for the real-time and delay sensitive application so as to increase the lifetime of the nodes of desired wireless network. Since, most of the sensor nodes in the network are equipped with low power batteries, it could be difficult for a sensor device to maintain for a long time if it send and receive data more often. In this paper we purpose the features of ZRP protocols and compare with QHCR..we propose a technique to minimize the consumption of energy as well as increase the lifetime of network .**

Index Terms- **ZRP, QHCR, Wireless sensor networks.**

1. INTRODUCTION

Wireless sensor networks (WSNs) have gained much atten-tion in the modern world because of their sensing capability. The micro-electro-mechanical system [1], [2] provides tiny low-power sensor nodes. The sensor nodes can sense, process, and then forward the data to other nodes for further investigation. The architecture of a tiny sensing node is shown in Fig. 1. Tiny sensing nodes can be applied to various elds to sense the required data. WSNs have found their way to many fields, such as health, industry, military, civil, and transportation systems [3] [6]. These sensing nodes have limited resources. Scarce resources with limited battery life demand from designers of tiny sensing nodes the design of energy-efficient platforms, operating systems, radio modules, and communication protocols for sensing nodes [7],[8].WSNs have been extensively employed to sense the diverse kind of data. The various challenging applications of the WSNs as has been discussed in [9] and [10], demand from sensor nodes to support the not only the energy efficient communications paradigms but also the delay sensitive support.

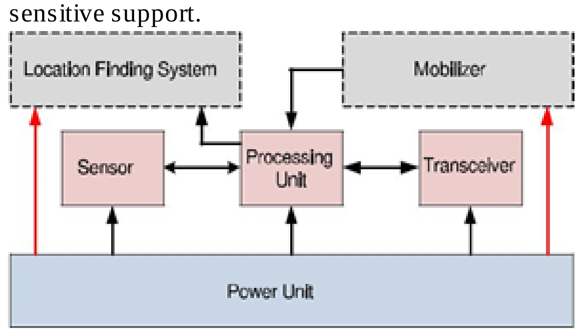


FIG 1. The architecture of the sensor node

It consists of power unit, sensor, processing unit, transceiver, location finding system and mobilizer. For this purpose, the energy-efficiency in WSNs have been regarded as the main motive for designing any communication protocol. The energy conservation in WSNs can be applied to various design patterns.

NEED FOR ENERGY MANAGEMENT IN WIRELESS SENSOR NETWORKS

The nodes in wireless network are constrained but limited battery power for their operation. Hence, energy management is an important issue in wireless networks. Energy management deals with the process of managing energy resources by means of controlling the battery recharge, adjusting the transmission power, and scheduling of power sources so as to increase the lifetime of the nodes of wireless sensor network. The energy efficiency of a node is defined as the ration of the amount of data delivered but the node to the total energy expended. The reasons for energy management in ad hoc wireless networks are:

As the field of mobile computing and communication advances, there is an increasing gap between the power consumption requirements and power availability and it adds to the importance of energy management [11].In situations like battlefields, it is difficult to replace or recharge the batteries. Hence, energy conservation is essential in such scenarios [12].Batteries tend to increase the size and weight of a mobile node, to reduce the size of the battery, energy management techniques are necessary to utilize the battery capacity in the best possible way.An optimal value for the transmission power increases the number of simultaneous transmissions.

If the relay traffic allowed through a node is more, then it may leads to a faster depletion of the power source for that node [14].Power consumption of a wireless radio depends on the operation mode. Operation modes of a radio can be categorized into the following: (i) transmit mode, (ii) receive mode, (iii) idle mode, and (iv) sleep mode.

2. RELATED WORKS

Energy efficient clustering routing protocols have gained much attention in WSNs. In these protocols, the sensing nodes are divided into smaller groups called clusters. One of the nodes in a cluster is assigned with more duties of communication than other nodes. This special node is called the CH, and the other nodes are referred to as member nodes. Member nodes send their sensed data to the CH. Then, the CH performs some type of data aggregation and then forwards that data to the BS. The whole clustering process classification is illustrated in Fig. 3. Different energy-efficient clustering protocols have been discussed in the literature [15] [16]. The following discusses some clustered and QoS-aware routing protocols, their main contributions, and some of their limitations.The equalized cluster head election routing proto-col (ECHERP) [17] is based on balanced clustering. In the QHCR protocol, optimal clustering is introduced with the help of various linear systems. The Gaussian problem solving approach is commonly used for the balanced election of CH. The energy-ef cient and QoS-aware routing (EEQR) [18] protocol addresses both issues (energy ef ciency and QoS). In the EEQR protocol, network traf c is prioritized on the basis of traf c content. A combination of static and mobile sink is devised to provide multi-paths for real-time traffic.The end-to-end delay is minimized by prioritizing network traffic. This approach enhances the network lifetime and stability of homogeneous WSNs. However, the EEQR protocol is limited by the fact that it does not address the heterogeneity of a network. Its performance usually drops when a heterogeneous network environment is used to ensure the QoS in WSNs.Priority-based application-specific congestion control clustering (PASCCC) [19] is another clustering approach to ensure QoS in WSNs. PASCCC minimizes congestion through the ef cient scheduling mechanism of CH. The packets of distant nodes are given higher priority by the CH than the packets of nearby nodes. This routing approach integrates the mobility feature of a sensing node. PASCCC also considers the heterogeneity of a network. However, the main limitation of PASCCC is that it does not address the delay for non-real-time traf c. Non-real-time packets suffer more in this routing approach, and thus the overall network throughput is affected.

To achieve a network with a long lifetime and low-energy consumption data acquisition, many effective routing protocols for WSNs have been proposed. Low energy adaptive clustering hierarchy (LEACH) [20] is one of the most popular clustering algorithms used in WSNs. In the LEACH algorithm, the operation is divided into rounds. Each round is defined by the setup phase and the steady phase. There are an optimal number of nodes that can be added to a cluster head in each round. However, LEACH assumes that the energy usage of each node with respect to the network is homogeneous, and it is not well suited for heterogeneous WSNs. In addition, the minimum transmission energy (MTE) and the direct transmission (DT) do not assure a balanced use of the energy by the sensor

3. NETWORK MODEL FOR ZRP

In WSNs, the energy efficiency directly affects the lifetime of the network and thus we should utilize the energy of the node efficiently. In this paper, we assume N nodes are deployed in a square that is divided into three equal regions: zone 0, zone 1 and zone 2. There are two types of nodes deployed in the network. The difference between these two types of nodes is their initial energy. Nodes with more initial battery energy are called advanced nodes, and the remaining nodes are called normal nodes. We consider that m fraction of the total nodes are advanced nodes equipped with α times more energy than normal nodes. The sensing area is $M \times M$ square meters, where the base station is stationary and high energy is located in the center. All nodes are stationary once deployed in the field and each node in the network has a unique ID. Some reasonable assumptions have been adopted as follows: 1) n sensor nodes are randomly distributed in the field; 2) the WSNs consists of heterogeneous nodes in terms of node energy; 3) the cluster heads perform data aggregation; 4) the base station is not energy limited in comparison with the energy of other nodes in the network.

Energy Model

In our research, we discuss the energy model, which is the same as previously defined [6]. When a node transmits k bit messages to a distance d, the equation to calculate the energy consumption [6] is given by Eq. (1):

$$E_{tx}(l,d) = \begin{cases} lE_e + lE_f d^2 \\ lE_e + lE_{mp} d^4 \end{cases} \quad (1)$$

Also, when a node receives k bit messages, the equation to calculate the energy consumption [6] is given by Eq. (2):

$$E_{RX(l)} = lE_e \quad (2)$$

where Ee is the energy dissipation per bit in the transmitter and receiver circuitry, d signifies the transmission distances, and do signifies the threshold distance. The parameters εfs and εmp are the energy consumption per bit in the radio frequency amplifyer. The distance is measured on the value of do, whose value is given by Eq. (3):

$$d_o = \sqrt{E_f / E_{mp}} \quad (3)$$

The energy dissipation for data aggregation is given above

$$E_{DA}(l) = lE_{DA} \quad (4)$$

As depicted in below equation , the detailed calculation of energy consumption for one cluster is given by:

$$E_{CH} = \left(\frac{n}{k} - 1\right) l * E_l + \left(\frac{n}{k}\right) l * E_D + l * E_e + l * E_{fs} * d^2{}_{to}$$ ____(5)

$$E_{nonCH} = l * E_e + l * E_{fs} * d^2{}_{CH}$$ _____(6)

$$E_{Clu} = E_{CH} + \frac{n}{k} E_{nonCH}$$ ________(7)

where ECH signifies the energy consumption of a cluster head, $EnonCH$ signifies the energy consumption of a member node of the cluster, k signifies the number of cluster heads, $dtoBS$ signifies the average distance between the cluster head and the base station and $dtoCH$ signifies the average distance between the cluster head and the cluster member. We substituted Eqs. (5) and (6) into Eq. (7). The total energy consumption in a round [7] can then be written as:

$$E_T = l\left(2nE_l + nE_{DA} + £_{fs}\left(kd^2{}_{toBS} + nd^2{}_{nonCH}\right)\right)$$ __(8)

Then, the optimal number of clusters [7] is given by:

$$k = \sqrt{\frac{£_{fs}}{£_{mp}}} \frac{\sqrt{n}}{\sqrt{2\pi}} \frac{M}{d^2{}_{to}}$$ _______(9)

The optimal number of clusters plays an important role in network clustering. Therefore, we selected the optimal number of clusters to minimize energy consumption. Last, the probability of becoming a cluster head of every node [7] is given by:

$$P_{opt} = \frac{k_{opt}}{N}$$ ______(10)

where N is the total number of nodes.

New Algorithm

In SEP, different weighted probabilities are assigned to normal nodes and advanced nodes to select the cluster heads. The one for normal nodes [7] is given by Eq. (11):

$$P_m = \frac{p_{opt}}{1+\alpha m}$$ _________(11)

The rest one for advanced nodes [7] is given by Eq. (12):

$$P_{adv} = \frac{p_{opt}}{1+\alpha m} * (1+\alpha)$$ ____(12)

4. NETWORK MODEL FOR QHCR

- In heterogeneous WSNs, the sensing nodes usually have different amounts of energy. Some nodes have more energy than other nodes.

- The four energy levels are categorized into low, medium, high, and hybrid energy levels.
- Heterogeneous WSNs are clustered by dividing the sensing nodes into different levels with respect to their initial energy.
- In our network model, we use a fourth level called the hybrid energy level.
- The hybrid level considers the energy of nodes that do not into the already defined two or three energy levels of the sensing nodes. Moreover, the nodes with energy that keeps fluctuating during various rounds for CHs elections can be accommodated into the hybrid energy level.
- The nodes with low energy level have *En* energy in the low energy level. However, the medium energy level nodes with fraction $r1$ have x times more energy than the lowenergy level nodes. The high energy level nodes with the fraction $r2$ have y times more energy than the low energy level node, and the hybrid energy level nodes of fraction ri have z times more energy than the low energy level nodes.
- The energy in the hybrid energy level nodes is defined in Eq.

$$HB = mri\, En(1 + z)$$

The initial energy of the high energy level nodes is given by

$HEN = mr2(1 - r3)En(1 + y)$

the energy of the medium energy level nodes is defined a

$$MEN = mr1(1\text{-}r2)En(1 + x)$$

The energy of the low energy level nodes:

$LEN = m(1\text{-}r1)En$

The total energy ET of the all nodes in the four energy levels is given in Eq.

$ET = HBEN + HEN + MEN + LEN$

$ET = (mriEn(1 + z)) + (mr2(1\text{-}r3)En(1 + y)) + (mr1(1 - r2)En(1 + x)) + (m(1\text{-}r1)En)$

- The network model consisting of four energy levels seems to have $r1(x+r2)(y+riz)$ times more energy than the single-level homogeneous network Assumptions:

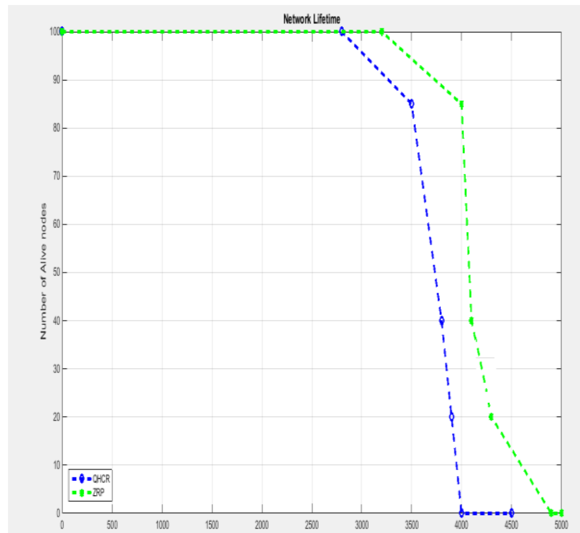
1. Sensing nodes are not mobile nodes.
2. CH has to receive and send data all the time. Network packets are of the same size.
3. BS is far away from the sensing nodes and is static in its position.
4. Transmission of data is highly sensitive to delay and loss. Sensing nodes have different amounts of energy from each other.

These assumptions help to design an energy efficient and QoS-aware routing approach for WSNs.

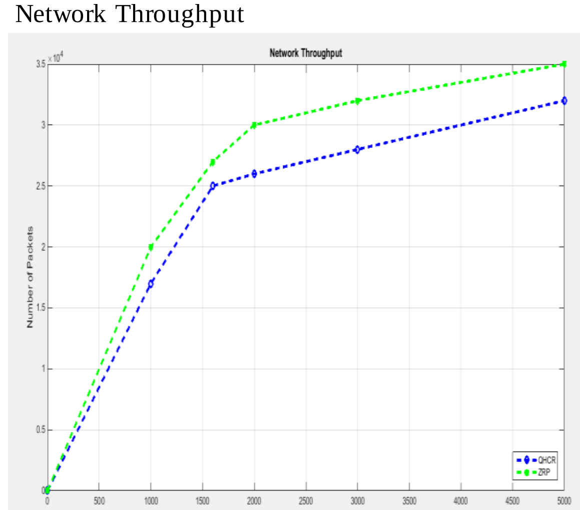
5. SIMULATION RESULTS

ZRP and QHCR simulated using NS-2 Tool and MATLAB shows graph

Network life time



Network Throughput

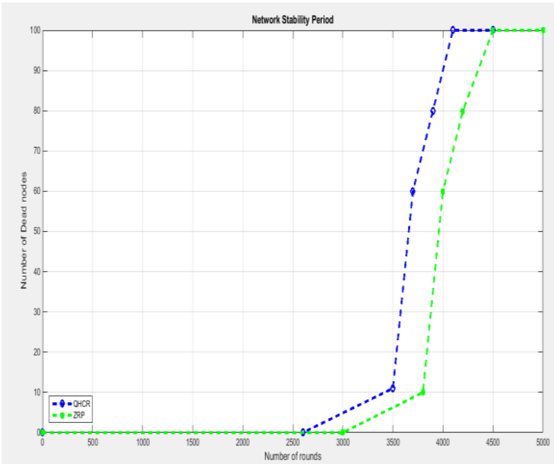


A. NETWORK LIFE TIME

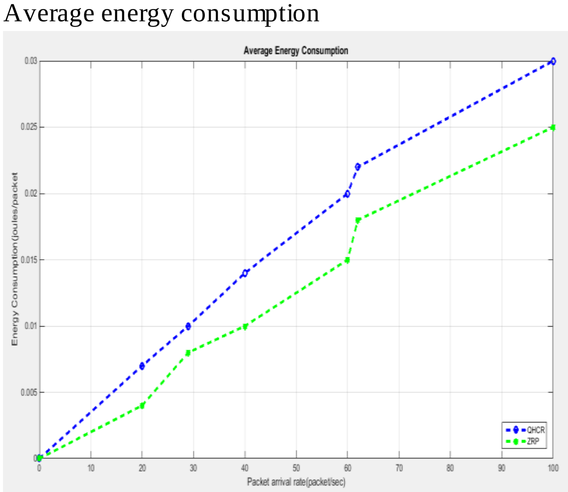
Network lifetime can be defined as the time period between the installation of the first node to the death of the last node. At the start of each round, energy of every node is calculated and based on that energy, the sensing nodes are grouped into different energy levels

Here ZRP has the better life time than QHCR

Network stability period



Average energy consumption



Network parameter

Network area	100*100
Number of nodes	30
Server location	175,375
Cluster radius	30m
Sensing radius	10m
Initial energy	0.5J
Number of rounds	5000

B. STABILITY PERIOD

Stability period can be defined as the period before the first node dies in the network

ZRP has the high stability period than QHCR

C.THROUGHTPUT

Throughput is defined as the number of packets sent to the BS at each round.it is important factor for protocol.based on throught value the protocol was selected for data transmission.

ZRP had the good throughput than QHCR

D. AVERAGE ENERGY CONSUMPTIONS

The average energy consumption in the ZRP Protocol is illustrated in Fig. The ZRP protocol has better energy efficiency than the other routing protocols of WSNs under consideration. This energy conservation is due to the optimal clustering of heterogeneous networks.

6. CONCLUSION AND FUTURE WORK

In this paper, We proposed the ZRP and QHCR protocol for wireless sensor networks using NS2 and performance evaluation was done by using MATLAB.

ZRP and QHCR protocols are animated using network tool NS-2 and performance evaluated using MATLAB.ZRP protocol network life time,thourghput,stability period and energy consumption were compared with QHCR protocol.ZRP has high perfotmance than QHCR. . In future, we intent to incorporate the energy-harvesting feature in our proposed routing approach for heterogeneous WSNs. The energy-harvesting feature will help in conserving the energy from some renewable energy source.

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