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Maximizing Network Lifetime in Wireless Sensor Network Using HEF

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Abstract:
Finding lifetime of sensor network is an essential part while using sensors for operation. Predicting the total lifetime of the network by Schedulability analysis and improving the network lifetime. In this paper we introduce a clustering algorithm for maximizing the lifetime of network called HEF algorithm and also adding an extra relay station to base station for effective transmission of packets. So we are avoiding the packet loss which results in saving energy for network to lead the activities to some time extend.

Key terms: Schedulability, relay station, clusters.

1. INTRODUCTION

Wireless Sensor Networks (WSNs) have a great number of nodes with sensing, computing, and wireless communication functionalities. WSNs are used in safety-critical or highly-reliable applications, two constraints are

- Real-time constraints
- Network life constraints

Two time constraints on WSN based safety critical systems time constraints. Real-time computing is the study of systems that should operate correctly under time constraints .There are two types of real-time systems:

Hard Real-time system:

It does not allow any task to miss its deadline.

Soft Real-time system:

It strives to satisfy deadline requirements statistically.

A typical HC-WSN is comprised of a base station, several cluster head nodes, and regular sensor nodes. For administrative purposes, the operation of a HC-WSN is divided into rounds in which sensor nodes are grouped into clusters. Each round consists of three phases:

- Cluster head selection
- Cluster formation
- Data communication.

The clustering process involves so many steps.

1) HEF selects cluster heads according to the energy remaining for each sensor node, and then the "setup" message (indicating cluster members, and the cluster head ID for each participated group) is sent to the cluster head of each cluster.

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2) The cluster head of each group broadcasts the "setup" message inviting the neighbour sensor nodes to join its group.

3) After receiving the "setup" message at this round, the regular sensors send the "join" message to its corresponding cluster head to commit to associate with the group.

4) Each cluster head acknowledges the commitment, and sends TDMA schedule to its cluster members.

5) All sensors perform its sensing and processing and communication tasks cooperatively at this clock cycle (round). Each sensor sends its energy information to its cluster head at the end of this clock cycle.

6) Upon collecting cluster members' information at a given period, the cluster head sends the summarise report to the base station.

2. ALGORITHM

2.1 HEF CLUSTERING

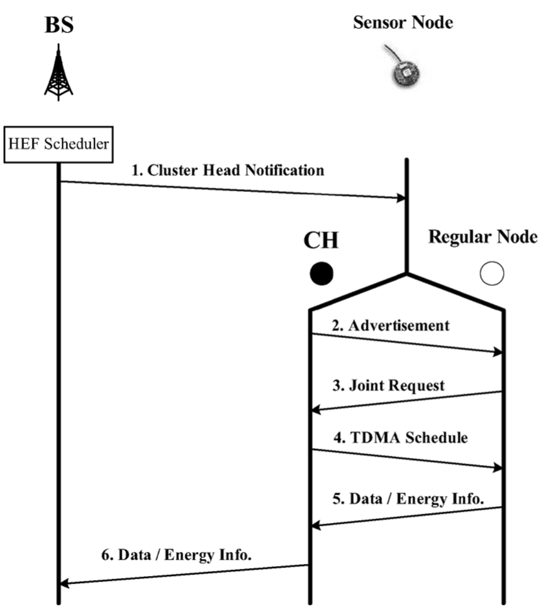

Fig 1: Information flow of the centralized HEF system.

2.2 ALGORITHM PHASES

HEF selects the set of highest ranking energy residue sensors for cluster heads at round where denotes the required cluster numbers at round. Some researchers have claimed that HEF is an efficient cluster selection algorithm that prolongs network lifetime based on simulations. However, their measurements and simulation results are stochastic processes. . Each round comprises the following three phases:

- CHS Phase,
- CFM Phase,
- DCM Phase.

2.2.1 Ideal Conditions for Optimality of HEF (ICOH):

1) All nodes must operate in a working-conserving mode. In other words, each node works as a clutter head, or a regular sensor in a round.

2) The energy consumptions of and are constant during the entire operation where, in the working-conserving mode, sensor nodes must consume energy at anytime while they operate.

2.3HIGH-ENERGY-FIRST(HEF) HEURISTIC

Based on above observations we propose a new heuristic to solve the target coverage problem. We observe that the granularity parameter *w* plays an important role in getting a better approximation of optimal

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solution. Hence prioritizing the sensors in terms of residual battery provides us better opportunity of using the sensors. HEF uses the three important steps in the following manner.

- Generate a cover
- Assign lifetime to a cover
- Change the priorities of the sensors

Schedulability test flowchart applies the worst-case energy consumption analysis to derive the predictability of HEF. Schedulability tests allow engineers to assess what actions (e.g. changing energy budget or lifetime, etc.) should be taken to improve the dependability and reliability of the systems. As shown in figure the Schedulability test flow chart consists of three major stages:

- Deployment Planning,
- Energy Estimation,
- Schedulability Analysis.

2.4 NETWORK LAYERS

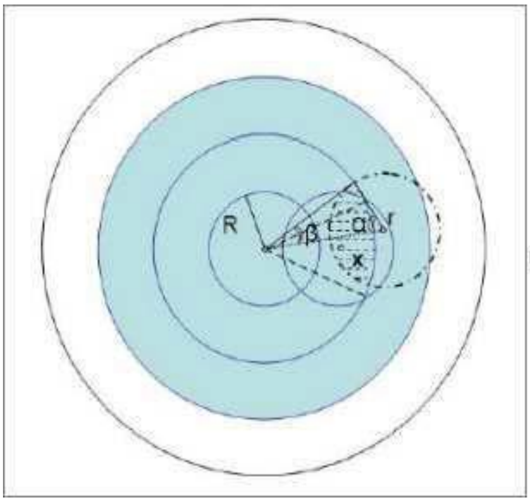

Fig 2: Sensor network divided into layers.

CONCLUSION

On providing a trustworthy system behaviour with a guaranteed hard network lifetime is a challenging task to safety-critical and highly-reliable WSN applications. For mission critical WSN applications, it is important to be aware of whether all sensors can meet their mandatory network lifetime requirements. In this project, we have addressed the issue of the predictability of collective timeliness for WSNs of interests. First, the High Energy First (HEF) algorithm is proven to be an optimal cluster head selection algorithm that maximizes a hard N-of-N lifetime for HC-WSNs under the ICOH condition. Then, we provide theoretical bounds on the feasibility test for the hard network lifetime for the HEF algorithm. Our experiment results show that the HEF algorithm achieves significant performance improvement over LEACH, and HEF's lifetime can be bounded. We have also developed formulas to derive the upper and lower bounds of the network lifetime quickly and easily (including both lose and sharp bounds). In particular, the feasibility test analysis performed in this paper presented a solution that would guide the system administrator to ensure that the system lifetime is predictable.

3. GRAPHICAL ANALYSIS

With the increase in initial energy, the lifetime for all schemes increases, but HEF prolongs the network lifetime as compared to LEACH when the initial energy becomes

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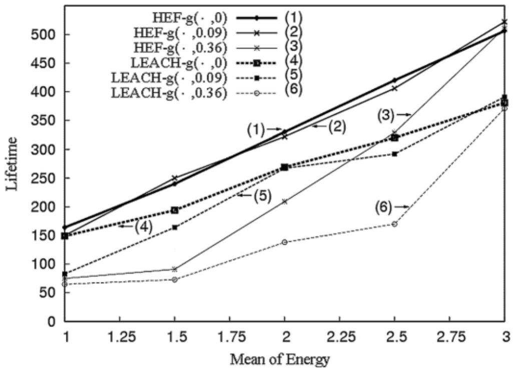
large enough. This result is because LEACH is unable to balance the energy consumption among the sensor nodes to avoid early energy depletion of the network. When the initial energy level is low, there is no significant performance difference between HEF and LEACH. However, HEF has better performance at a small variance. The HEF algorithm performs better out of all LEACH schemes under high initial energy level. In this experiment, HEF surpasses LEACH by taking into account network lifetime when they have the same initial energy level.



3.1 TABLE I

Simulation Parameters

Parameters	value
Number of nodes	100
Number of clusters	5
Network size	100mX100m
Base station location	(50,180)
Radio speed	1Mbps
Header size	25 bytes
Packet size	500 bytes
Radio electronics energy	50 nJ/bit
Compression ratio	0.5

4. SCOPE OF FUTURE WORK

Minimizing the packet loss by adding extra stations to receive. In addition to the base station we have use another terminal station to receive the data packets during the transmission.

5. ADVANTAGES

- Loss of packets will be reduced.
- Energy loss is avoided.
- Time consumption.

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