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Heuristic Approaches for Scheduling of Mobile Sensors in a Decentralized Manner

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Abstract: ***Wireless sensor network consists of two types of nodes static nodes and mobile nodes. Static nodes are fixed whereas mobile nodes are movable in nature their position are not fixed. To efficiently schedule the routing process is difficult in case of random distribution of sensor network as at some time there is network failure, packet drop; sometime the nodes are in idle our sleep mode but still there is energy loss. These factors influence the delay, throughput and energy consumption by nodes. Current approaches are complex while considering the performance of the system, but we only consider the simplest but optimal solution. Routing efficiency of sensors as well as reducing energy consumption is our goal as well as energy optimization is our another goal therefore they must be scheduled to reduce and balance the moving distances as well as their speed and displacements must also be observed. Therefore apart from other heuristic approaches or schemes, our approach divided into two phases presented in decentralized version accomplishes the targeted goal*.**

Keywords: Heuristic, Optimization, Delay, Routing, Throughput, Decentralized

1. Introduction

Heuristic approaches are simply decision taking mechanisms which gives us satisfactory solution not optimal solution. These approaches speed up the solution or our efforts .these approaches are readily accessible, scalable in nature. These approaches are capable to solve various issues regarding energy management routing efficiency, connectivity, decentralized or centralized .Sensor network has many application regarding military where there is a rapid deployment, self organizing capability shows potential in them to use at such extend. Sensor nodes or mobile nodes can be used to detect different events or attributes this feature is somehow inbuilt but the performance differs according to the environment. At environmental sensors are deployed at wider ranges which are almost undetectable or cannot be monitored.

On the other hand there are applications of mobile sensors related to medical as well as home applications. For better performance the delay, the fraction of transmitting with respect to receiving packets must be constant as well as energy must be conserved. The topology of the sensor network differs according to the application. Hence the most sensing capability is of mobile nodes or sensor nodes as well as they have computing capability so there must be an approach which considers computational overhead also. Earlier mobile sensors were considered for monitoring schemes .once they are randomly deployed, monitoring there various issues or constraints were difficult due to mainly random deployment and mobility of nodes.

Occurrence and sensing of events are unpredictable. It depends on computational and sensing capability of nodes. The energy spent or consumed should be considered to conserve it. The increasing density of mobile nodes or sensor nodes may improve the performance but can contribute to congestion, multiple link failures. Designing of an efficient wireless sensor network is far more complicated as well as costly, due to limitations in resources. Our necessity is to resolve issues regarding energy with minimum utilization of energy. There are many clustering approaches and algorithms as well as there are many heuristics schemes proposed but still issues regarding delay, energy or throughput still exist. In this paper, we have proposed two phase mechanism phase I identifies heuristics and phaseII is application of heuristic and cluster head communication both simultaneously which gives simulation results regarding delay, throughput and energy.

2. Design Issues

There are various constraints raising issues in sensor networks such as issues related to energy management as per routing techniques it differs as much the sensors uses mutlihop technique the energy can be saved instead of direct communication but it has an disadvantage that it makes the topology complicated which results in multiple link failure. Moreover node deployment differs according to the situation it is mostly random and the nodes are scattered.

The deployment can be either self organizing or deterministic or are placed manually. However in the self organizing characteristic of sensor nodes they create their own structure which is applicable and very common in adhoc networks, another issue is regarding management either through distributed or centralized. Both types of management have their own advantages and disadvantages. As per the innumerable applications of sensor networks there are many limitations regarding resources and their utilization. The most important issue is energy which plays a crucial role whether in case of transmission and reception of packets, sensing of data or monitoring.

3. Related Work

There has been investigation regarding energy conservation, events detection, scheduling of sensors, clustering

techniques. In heterogeneous sensor networks voronoi [9] clusters are deployed and by a tabu search meta heuristic [9] a new secured routing technique is applied for routing purpose of cluster head to a base station. Then for a fixed cluster head and its distribution, clustering technique is used to choose number of clusters and this technique will be applied using a zigbee standard. Another modified version of the above procedure is a modification in cluster-tree topology for cluster head role distribution based on modified AODV and some cluster-tree protocols. This modified AODV based on a weighted value chooses a cluster-head [19].

Another management technique is probabilistic management which includes node willingness, its cooperation, monitoring cost .based on spatial dimension adjacent nodes and their temporal one having highest probability is considered. Other than this there are various heuristic localized schemes or algorithms such as Nearest to BS first algorithms, Max-residual –capacity-first algorithm and best-effort relaying algorithm [20]. These algorithms are used for placement of relay nodes and as design principals to study residual capacity of nodes and to resolve issues related to lifetime or connectivity. Another is a two-phase heuristic dispatch for scheduling of sensors. The phases are distributed in pareto-optimality and spanning tree construction for calculations of assignments and to detect and visit unassigned attributes or event [18]. Nevertheless the packet loss, sensing, communication, routing efficiency is not considered and the design the behavior of sensor nodes to work in a decentralized version is not considered. Therefore our approach helps to study the behavior and reduces energy consumption as well as improves routing efficiency of sensor nodes to some extent.

4. Proposed Scheme

After studying and considering all the different approaches given above, we used another but different approach which is a combination of assigning heuristics (energy, speed and displacement) to the sensors and combining it with cluster-head based communication. In phase I we find heuristics which is a procedure of detecting nodes which has crossed the assigned limitation of energy consumption, speed and distance. In phase II the cluster head is selected among the nodes having highest energy. Through this two cluster head at a time are selected having first highest and second highest energy. Then the communication path is fixed it goes through source to first cluster- head to second cluster-head and then to sink node. The advantage in this path is in case a cluster-head fails another cluster head can communicate. And in case if both the cluster head fails source can directly communicate with the sink node or relay from nearby destination node. This phase is again subdivided into four stages: At first the comparison is done without applying any of the phases. At second stage the comparison is done without applying phase I but applying phase II. At the third stage phase I is applied and phase II is not applied. Then at last stage both phase I and II is applied and the results is compared simultaneously of all the four stages regarding simulations in terms of energy, delay and throughput.

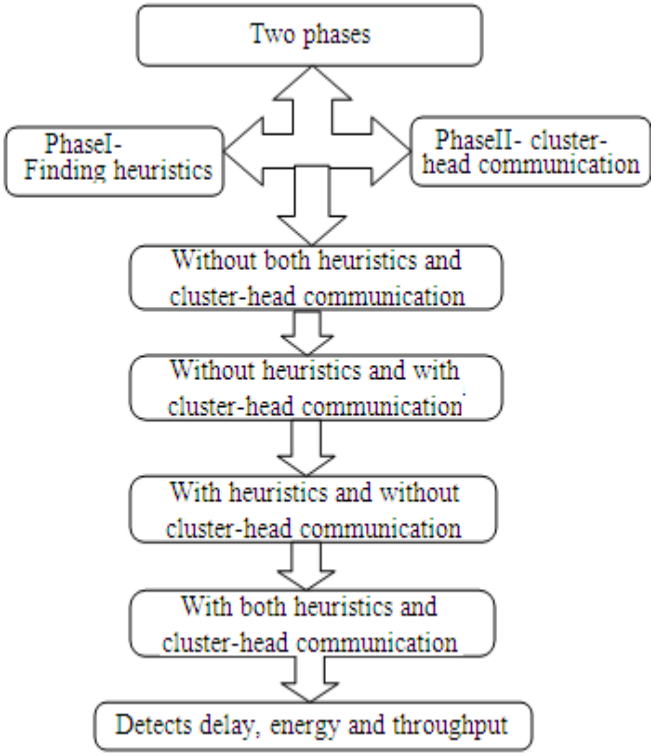

Figure1: Process diagram of proposed scheme

5. Results

The simulation result shows the energy consumption at different instant of time (fig- 2).In this we can observe the comparison of various stages at each instant of time. The result shows the energy loss i.e. combination of both heuristics and cluster-head communication (hc) is far less than every stage which is without heuristics and with cluster-head communication(c) and with heuristics and without cluster-head (h). The highest energy consumption is in without both heuristics and cluster-head.

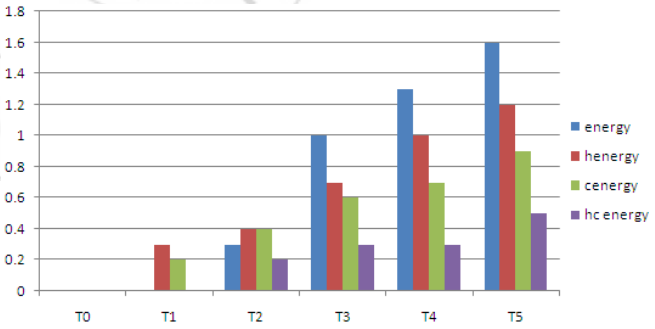

Figure 2: Comparison of energy consumption in the four stages with respect to time.

The simulation result shows the delay at different instant of time (fig-3).In this we can observe the comparison of various stages at each instant of time. The result shows the delay in combination of both heuristics and cluster-head communication (hc) is far less than every stage which is without heuristics and with cluster-head communication(c) and with heuristics and without cluster-head (h). The delay is more in without both heuristics and cluster-head communication.

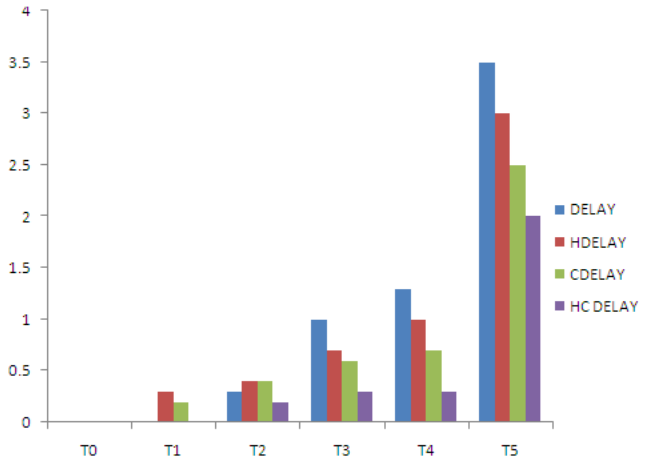

Figure 3: Comparison of delay in the four stages with respect to time.

The simulation result shows the variation in throughput at different instant of time (fig- 4).in this we can observe the comparison of various stages at each instant of time. The result shows the throughput drop in combination of both heuristics and cluster-head communication (hc) is far less than every stage which is without heuristics and with cluster-head communication(c) and with heuristics and without cluster-head (h). The drop in throughput is more in without both heuristics and cluster-head with respect to time.

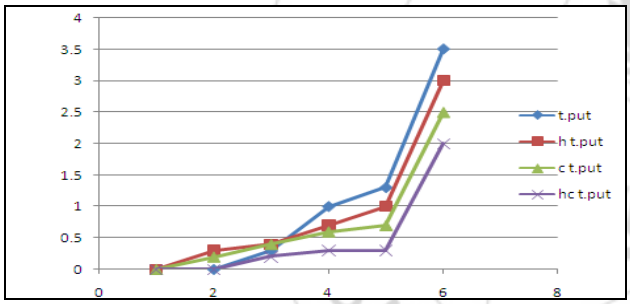

Figure 4: Comparison of variation in throughput in the four stages with respect to time.

6. Conclusion and Future Work

The results may vary as the distribution of sensors is random and their position is not fixed. A heuristic technique is less complex, easy for implementation and does satisfy our goals. However in our approach after studying and comparing the results one can easily observe the energy consumption of a sensor and the delay with a constant throughput with respect to time. So that a detailed study can be made on the basis of results that we get by comparing energy, delay and throughput after applying our scheme. Our approach is far easier to implement and less complicated as well as the approach is scalable to the sensor network and also adaptable. Since we have not considered security feature this can be modified within our approach for better performance and generic solutions

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