# Centralized Distributed System for Wireless Sensor Network: Investigation Algorithm

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***Abstract:*** We have simulated HADEEPS and HALBPS for different deployments. We have focused on the energy heterogeneity and present a set of distributed algorithm for scheduling sensors, adjust the transmission or sensing ranges of sensor node and implementing a heterogeneous energy model to enhance the complete lifetime of WSNs. We have two dimensional sensor node networks with known initial energy and sensor and target positions and they are randomly distributed in different forms such as triangular, square and hexagonal. These arrays of sensors are compared using two approaches HADEEPS and HALBPS in terms of lifetime for heterogeneous networks. The simulations results indicate the overall network lifetime significantly improve with both HADEEPS and HALBPS protocols in case of triangular deployment for linear and quadratic energy models. Finally, we have simulated the Energy Efficient Data gathering Protocol for Adjustable Range Sensing with Heterogeneity (AEEDPSH) and Data gathering Load Balancing Protocol for Adjustable Range Sensing with Heterogeneity (ADLBPSH) for the different adjustable sensing ranges.

***IndexTerms* - Network. Data, Protocol, Energy, Range.**

## I. INTRODUCTION

Firstly, we have focused on the comparative study of distributed algorithms (ALBPS, HALBPS, ADEEPS and HADEEPS) for maximized Lifetime of wireless sensor networks with different number of targets and sensors. We have introduced, Heterogeneous Adjustable Range DeterministicEnergyEfficientProtocol (HADEEPS) and Heterogeneous Adjustable Range Load Balancing Protocol (HALBPS) based on distance and residual energy of each node to go into active state with active range. The simulation results show that the overall network lifetime significantly improve with HADEEPS and HALBPS in comparison to existing protocol ADEEPS and ALBPS in case of linear and quadratic energy models. Distributed algorithms perform well in case of heterogeneity and adjust the sensing ranges of the sensor nodes. Secondly, we have simulated HADEEPS and HALBPS for different deployments. We have focused on the energy heterogeneity and present a set of distributed algorithm for scheduling sensors, adjust the transmission or sensing ranges of sensor node and implementing a heterogeneous energy model to enhance the complete lifetime of WSNs. We have two dimensional sensor node networks with known initial energy and sensor and target positions and they are randomly distributed in different forms such as triangular, square and hexagonal. These arrays of sensors are compared using two approaches HADEEPS and HALBPS in terms of lifetime for heterogeneous networks. The simulations results indicate the overall network lifetime significantly improve with both HADEEPS and HALBPS protocols in case of triangular deployment for linear and quadratic energy models. Finally, we have simulated the Energy Efficient Data gathering Protocol for Adjustable Range Sensing with Heterogeneity (AEEDPSH) and Data gathering Load Balancing Protocol for Adjustable Range Sensing with Heterogeneity (ADLBPSH) for the different adjustable sensing ranges. In the selection of head node, the heads gather data from sensor nodes aggregate it and then send the information to the base station. In this way, the sensor nodes can reduce communication overheads that may be generated if each sensor node reports sensed data to the base station independently. Here, we have considered that the sensor nodes and base-station are not mobile. We have proposed new centralized energy efficient algorithms, AEEDPSH and ADLBPSH, based on the distance from the base station and sensor residual energy as well as scheduling of sensor nodes to alternate between sleep and active mode. Each node communicates only with the nearest neighbor and takes turns transmitting to the base station, thus reducing the amount of energy spent per round. The simulation results illustrate that the proposed algorithms AEEDPSH and ADLBPSH balance the energy dissipation over the whole network thus prolonging the network lifetime.A Wireless Sensor Network (WSN) defined as a network of (possibly low-size, low-battery power and low-complex) devices denoted as nodes that can sense the environment and communicate the information gathered from the monitored field (such as an area or volume) through wireless links; the sensed data is forwarded, possibly via multiple hops relaying, to a sink (controller or monitor) that can use it locally, or is connected to other networks (e.g., the Internet) through a gateway. It is a rapidly emerging field which will have a strong impact on research and will become an integral part of our lives in the near future. The huge application space of WSNs covers national security, surveillance, military, health care, environment monitoring and many more. Due to their wide-range of potential applications, WSNs have attracted considerable research interest in recent years [3].A wireless sensor network is composed of a large number of low-power, low-cost sensor nodes which are deployed close to an area of interest and are connected by a wireless RF interface. Sensor nodes are tiny devices equipped with sensing hardware, transceivers, processing and storage resources and batteries. The task of sensing, computation, and communication is performed into a single tiny device. In general, the sensors nodes are deployed randomly and not required to be engineered or predetermined. This allows fast random deployment in inaccessible terrains or disaster relief operations. However, this random deployment requires that sensor network protocols and algorithms must possess self organizing capabilities.After the deployment, these nodes are generally stationary and self-organized into networks. They gather information about the monitoring region and send this information to gateway node's where end users can retrieve the data [3]. In this way, the sensor network provides the information and a better understanding of the monitored region.The unique power of WSNs lies in the ability to deploy a large number of tiny sensor nodes which can assemble and configure themselves as a network. The network could be easily extended by simply adding more sensor nodes with no rework or complex reconfiguration.In contrast to traditional wireless networks, the sensor nodes in WSNs do not necessarily need to communicate directly with the nearest high power control center, but mostly with their neighboring sensor nodes and each individual sensor node becomes part of an overall infrastructure. In addition, the network can automatically adapt to compensate for node failures. When compared with traditional ad-hoc networks, WSNs have some limitations such as limitation in power, computational capacities and memory. Sensor nodes carry limited power supply which are generally irreplaceable and may be deployed with non-rechargeable batteries. Since the sensor nodes will die one after another during the operation of the network, all the network requirements must be met with minimum power consumption due to battery limitations, and in most applications, it is impossible to replenish power resources.

## II. Wireless Sensor Networks

Wireless sensor networks (WSNs) contain hundreds or thousands of sensor nodes equipped with sensing, computing and communication abilities. Each node has the ability to sense elements of its environment, perform simple computations, and communicate among its peers or directly to an external base station. The position of sensor nodes need not be engineered o r predetermined. This allows random deployment in inaccessible terrains or disaster relief operations. On the other hand,this also means that sensor network protocols and algorithms must possess self- organizing capabilities. Another unique feature of sensor networks is the cooperative effort of sensor nodes. Sensor nodes are fitted with an onboard processor. Instead of sending the raw data to the nodes responsible for the fusion, they use their processing abilities to locally carry out simple computations and transmit only the required and partially processed data [11, 13].

## III. Sensor Networks Communication Architecture

The sensor nodes are usually scattered in a sensor field as shown in Figure 1.2. Each of these scattered sensor nodes has the capabilities to collect data and route data back to the sink and the end users [15]. Data are routed back to the end user by a multihop infrastructure less architecture through the sink as shown in Figure 1.2. The sink may communicate with the task manager node via Internet or Satellite.

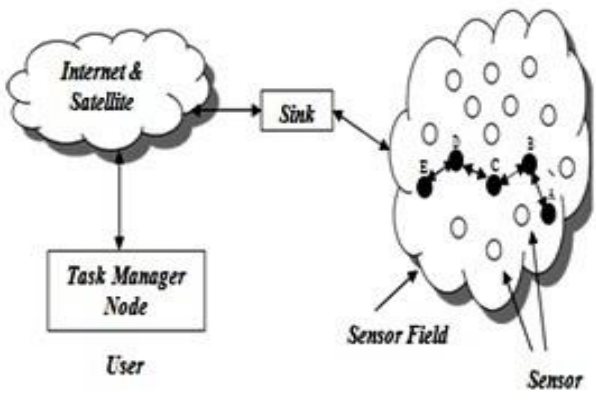


Figure 1.2 Sensor nodes scattered in the field [11].

## IV. Proposed Modified Distributed Algorithms

In this paper, the distributed algorithms proposed in [1] have been modified using the different adjustable range sensors and Heterogeneous energy model. In [1], the authors propose efficient distributed algorithms for improving network lifetime for adjustable sensing range network.

The basic step in ALBPS and ADEEPS is that each node has to decide whether they can go to sleep or become active and cover the targets. Each sensor knows its neighboring sensors and covered targets. After exchanging their battery power and covered targets, using the rules, each sensor decides whether they go to sleep or become active covering the target. In both algorithms, the decision is made on the energy level, and the distance.

In the new algorithms HALBPS and HADEEPS, both the energy level and distance are considered in the sensors decisions. The following shows the steps in our simulation:

*Step:-1.* Targets and sensors are read into the memory.

*Step:-2.* Sensor nodes are in a deciding state and decide whether they can go to sleep or become active and cover the target.

*Step:-3.* All the sensor nodes know about its energy level, sensor id and target id. The energy consumption level of the sensor depends on the energy model. It can be either linear or quadratic energy with a new heterogeneous model.

*Step:-4.*Each sensor knows its neighboring sensors, neighboring sensors distance and covered targets.

*Step:-5.* For the each sensor

- *In Heterogeneous Adjustable Range Load Balancing Protocol (HALBPS),* checks with each neighbor sensors starting from the farthest target whether that target can be covered by the neighbor sensor with larger battery level. If the neighbors target can cover the farthest target with larger battery level, then the sensor removes that target from the covered target list and reduces the sensing range to the next target. This sensor will go to sleep if the range reaches zero. This process stops after all sensors make a decision.
- *In Heterogeneous Adjustable Range Deterministic Energy-Efficiency Protocol(HADEEPS),* each sensor decides which targets they are in-charge of by using the maximum lifetime of all the targets of its neighbors. After making this decision, each sensor decides to become active with range $r$ ($r \leq$ maximum sensing range) or decides to sleep. This process stops after all sensors make a decision.

*Step:-6.* After all sensors decide their state to be active or idle, each sensor will stay in that state for a certain period of time (shuffle time) or until there is an active sensor which exhausts its energy supply and is going to die. All sensors are alerted using wake-up call causing all sensors to change their state back to the deciding state with their maximum sensing range and repeat the process from step 5.

*Step:-7.* This simulation is repeated until a target cannot be covered.

*Step:-8*. Then, the process terminates and the lifetime of the network is printed out.

## V. PROTOCOL DESIGN REQUIREMENTS

A WSN possesses a lot of constraints, protocols designed for them must satisfy many special requirements to overcome those constraints. Some of the most critical requirements are:

### 6.1 Energy-efficiency

A sensor is a battery-driven device and in most cases, the battery is irreplaceable. However, every operation of a sensor consumes a certain amount of energy. Thus, to lengthen network lifetime, a sensor network protocol must take energy into account, or in other words, it must be energy-efficient. To date, the best way to energy-efficiently maximize network lifetime is to balance energy consumption among all the sensors in the network. That is, the more energetic sensors must have more chance to be active, and the more exhausted ones should have more chance to go to sleep [27].

### 6.2 Robustness

Sensors are unreliable devices. Besides, they are usually deployed in big regions under tough conditions. Thus, a sensor may unpredictably die, may be temporarily go out of service at any time for various reasons, or a sensor's battery may deplete at any time. It is also possible that some new sensors join the network.

### 6.3 Fault-tolerance

Sensor network is a prone-to-failure network [11, 12], and a sensor is an unreliable device equipped with a communication system with high failure-rate and unreliable sensing components. Thus, to guarantee the correctness and integrity of sensed data, protocols designed for WSNs must provide high fault-tolerance.

### 6.4 Distributed and parallel algorithms

Sensors have very limited computational ability and a very small memory size. Therefore, they are not able to execute a complex algorithm. The burden of running any algorithm should be shared among sensors in the network. Besides, a WSN is a scalable network comprising of a large number of sensors, and the topology of a sensor network may change very frequently. Thus, the converge-time (i.e. time complexity) of any algorithms for WSN needs to be short enough to keep up with the changes in the networks. For these reasons, in most cases, only localized, distributed and parallel algorithms are suitable for WSNs. Notice that there exist decentralized but non-parallel (i.e. Sequential) algorithms for which sensors even require only local information, but they have to wait for neighbors before making decisions, usually sleep/active decisions. This kind of algorithms is clearly not suitable for WSN since their time complexity is no smaller than sequential algorithms [2].

## VII. CONCLUSION

Presently the network model, proposed modified distributed algorithms, performance evaluation criteria and simulation setup that have been used in the thesis to carry out the research. The work has been carried out by using C++. The simulation setup and its implementation have been reported in this chapter. In this chapter, we have also explained modified distributed algorithms using the different adjustable range sensors and node heterogeneity. We have tested the performance of the algorithms by simulating it over a wide range of simulation parameters. Chapter-3, describe the simulation and comparative analysis of the distributed algorithms (ALBPS, HALBPS, ADEEPS and HADEEPS) for maximizing the lifetime of WSNs with heterogeneity for adjustable sensing range. the simulation and comparative analysis of the distributed algorithms (HALBPS and HADEEPS) for maximizing lifetime of WSNs with heterogeneity and adjustable range for different deployment strategies. The simulation and comparative analysis of the energy-efficient data gathering algorithms (DALBPSH and AEEDPSH) for improving lifetime of WSNs with heterogeneity and adjustable sensing range has been done. The high compression rate will help to reduce energy consumption during the data transmission process, and the high response speed will help the work with high efficiency. This method can also be used in other object motion or deformation with large range and other field to improve the monitoring efficiency.

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