Delay And Energy Minimization In Wireless Sensor Networks Using Particle Swarm Optimization And Optimized Transmission

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Abstract- *Wireless Sensor Networks (WSN) have several applications in large scale industries, defense, climate monitoring, automation, medicine etc. The active areas of research in WSNs are reducing the energy consumption and delay in data transmission. In this proposed work, an energy-aware clustering for wireless sensor networks using Particle Swarm Optimization (PSO) algorithm which is implemented at the base station is presented. We define a new cost function, with the objective of simultaneously minimizing the intra-cluster distance and optimizing the energy consumption of the network.*

Keywords- Wireless Sensor Network (WSN), Particle Swarm Optimization, Optimized Transmission, Energy Consumption, Network Delay.

I. INTRODUCTION

Wireless Sensor Network is collection of numbers of sensor nodes. Sensor nodes gather the sensory information and communicating with other nodes in networks. Sensor node contain the microcontroller, transreciver, external memory and sensors. Key Challenges in wireless sensor network is saving energy and extend the network life time. To increase the capability of networks, clustering techniques is used. In Clustering techniques, all node are divided into servral cluster and one of the sensor node is elected as Cluster Head(CH) and rest are cluster member(CM). Only Cluster Head(CH) can collect the data from the other node and send to base station. For the data transference in wireless sensor network and selection of Cluster Head many clustering based routing protocols are used.

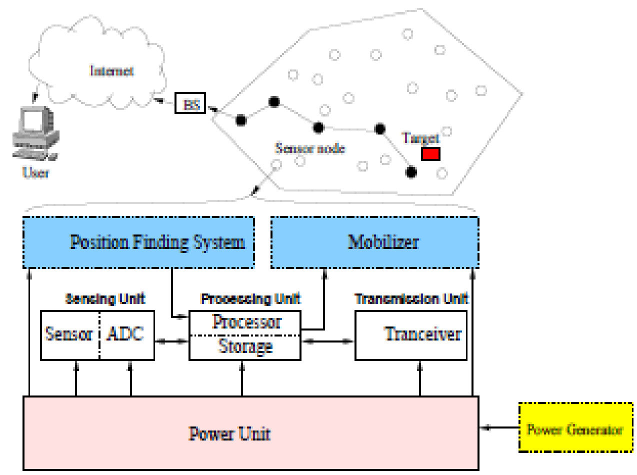

Fig.1 Components of a Sensor Node

II. APPLICATIONS OF WIRELESS SENSOR NETWORKS

Wireless Sensor Networks are formed by tiny sensing devices for wireless communication, actuation, control and monitoring. Given the potential benefits offered by these networks like simple deployment, low cost, lack of cabling and mobility they providing numerous applications among which some are categorized below:

Disaster Relief Operations: The WSN framework structural planning for flood forecasting comprises of sensors (which sense and gather the information applicable for counts), a few nodes alluded to as computational nods and a manned focal checking office (which checks the results with the accessible online data, executes an incorporated rendition of the forecast calculation as an excess system, issues cautions and starts departure strategies). Diverse sorts of sensors are obliged to sense water release from dam, precipitation, stickiness, temperature, and so on. The information gathered by these sensors are utilized within the flood prediction calculation. The computational nodes have compelling CPUs needed to execute the appropriated expectation model. The computational nodes should impart the forecast results to the observing node. They additionally have correspondence between themselves for discovering breaking down of nodes.

Intelligent Buildings/Bridges: To reduce the energy use of buildings, WSNs could be deployed to measure temperature, humidity and air flow, which then could be used to adapt the temperature within the building automatically. Also sensors could be used to monitor the mechanical stress level of buildings, such as bridges, to find out the likelihood of a collapse.

Biodiversity Mapping: WSNs can be used, for example, to monitor the erosion processes on the ground of the ocean. Closely related is biodiversity mapping in which a number of plants or animals in a certain region are monitored.

Building Architecture: In larger facilities with multiple buildings sensors could be used to track vehicles in that area or to detect intruders. Another application could be the deployment of sensors in a chemical plant to detect leaking chemicals.

Precision Agriculture: Remote Sensing directs the farmer's efforts towards crop needs of water, nutrients and other attention. The information provided enables the farmer to act significantly to the problems with minimal investment by knowledge of land, need and quantity. Development of wider array of such devices greatly benefits the agriculture sector. Sensor networks integrate spatiotemporal patterns and trends in climate, pressure, motion, hydrology, soil moisture and reports best management options to agriculture manager.

Military Applications: To sense the movement of army, WSNs are mined over a wide area and is further subjected to sense biological or chemical explosives. The military rely on this technique for strategy formation and defence mechanisms. The objective of a typical ground surveillance system is to alert the military command to targets of interest, such as moving vehicles and personnel in hostile regions. Such missions typically require a higher component possibility regarding human being in addition to need a high penetration of stealthiness. Hence, the ability to deploy unmanned surveillance missions, by employing wireless sensor networks, is associated with great realistic importance for the military. Effective recognition, arrangement, and following oblige an observation framework to get the current position of a vehicle and its signature with worthy accuracy and trust. At the point when the data is received, it must be accounted for to a remote base station inside a satisfactory inactivity.

Medicine and Health care: Sensors can be placed at certain items, such as parcels, to allow a simple tracking of objects during transportation or within a warehouse.

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III. SYSTEM DESIGN

The wireless sensor networks have been an area of extensive research and study in the recent few years. As the energy consumption and delay minimization have been major attributes of performance of a wireless sensor network. Many previous methods and approaches have been put forth in this context for minimization of the time energy consumed. One such method was the improvement in the media access layer. Also the concept of clusters seemed to provide an optimal solution to a great extent. Two more real difficulties are the manner by which to place the cluster heads over the network and what number of clusters would be there in a framework. Also the power consumption parameter hugely impacts the overall network functioning effectiveness and power of the sensor node. So here several researches are being made on the power saving aspect of the sensor nodes in the WSN's so as to improve the overall network lifetime. So the motivation has been to enhance the overall network lifetime in the wireless sensor network for better performance. The proposed algorithm uses the particle swarm optimization (PSO) for clustered wireless sensor routing. The PSO algorithm is an evolutionary computing technique, modeled after the social behavior of a flock of birds. In the context of PSO, a swarm refers to a number of potential solutions to the optimization problem, where each potential solution is referred to as a particle. The aim of the PSO is to find the particle position that results in the best evaluation of a given fitness function. In the initialization process of PSO, each particle is given initial parameters randomly and is 'flown' through the multi-dimensional search space. During each generation, each particle uses the information about its previous best individual position and global best position to maximize the probability of moving towards a better solution space that will result in a better fitness. When a fitness better than the individual best fitness is found, it will be used to replace the individual best fitness and update its candidate solution according to the following equations:

$$v_{id}(t) = w \times v_{id}(t-1) + c_1 Ø_1(p_{id} - x_{id}(t1)) + c_2 Ø_2(p_{gd} - x_{id}(t-1)) \quad (1)$$

$$x_{id}(t) = x_{id}(t-1) + v_{id}(t) \quad (2)$$

List of variables used in PSO equations.

v	The particle velocity
x	The particle position
t	Time
c_1, c_2	Learning factors
Φ_1, Φ_2	Random numbers between 0 and 1
p_{id}	Particle's best position
p_{gd}	Global best position
w	Inertia weight

Although PSO is suitable for solving multi-dimensional function optimization in continuous space and the parallel computing mechanism is adopted in, the execution time is still a big bottleneck of PSO, especially for large scale wireless sensor networks which consist of lots of mobile sensor nodes. According to it, the velocities of particles are updated according to their corresponding experience and the experience of their companions for pulling each particle toward local best and global best positions in PSO. However, because the initialized positions and velocities of particles are generated by a random term, the convergence speed is partially determined by the initialized parameters of particles. Moreover, the local best and global best positions may not be the optimal results, especially in the forepart of optimization, which will impact the convergence of optimization.

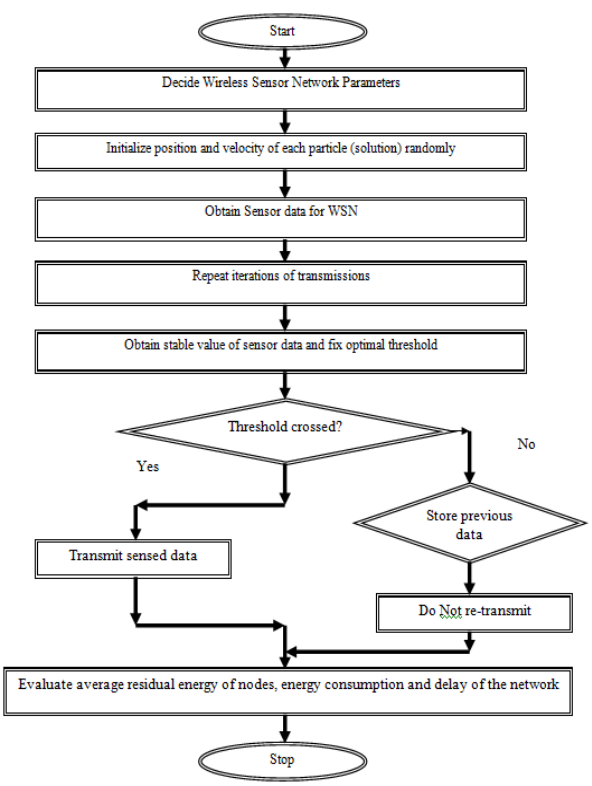

Fig.2 Flowchart of Proposed System

IV. RESULTS

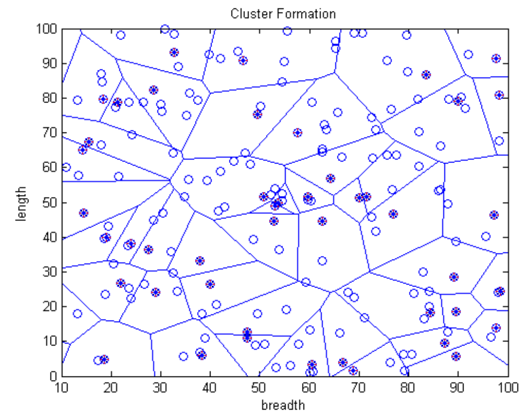

Fig.3 Initial Clustering

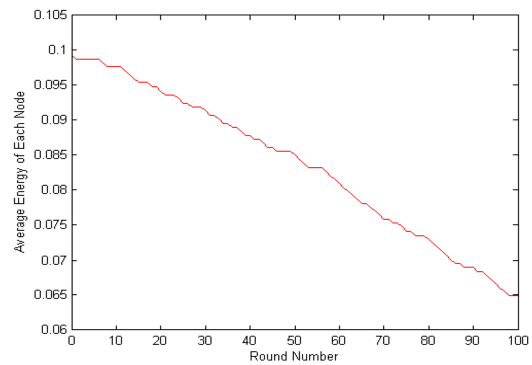

Fig.4 Average Energy of Nodes

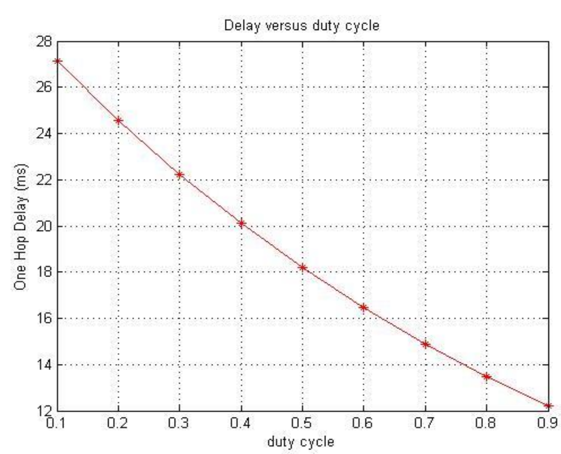

Fig.5 One hop Delay versus duty cycle

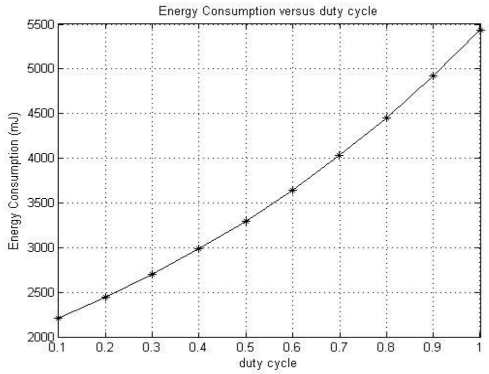

Fig.6 Energy Consumption versus duty cycle for r=8

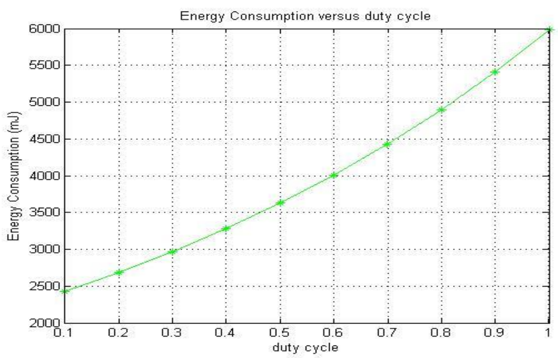

Fig.7 Energy Consumption versus duty cycle for r=100

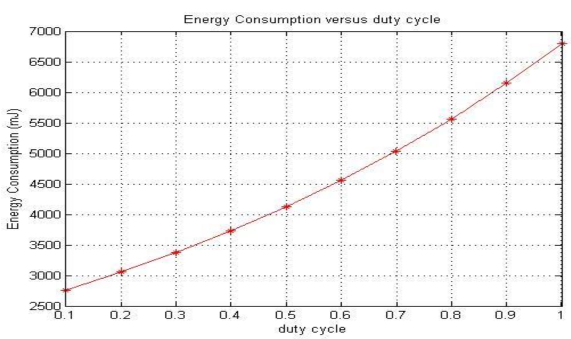

Fig.8 Energy Consumption versus duty cycle for r=120

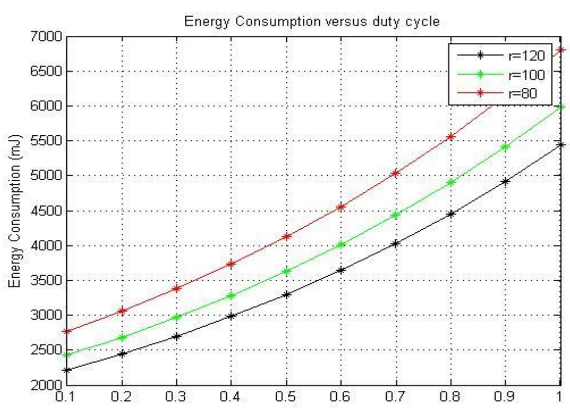

Fig.9 Energy Consumption versus duty cycle for variations in values of r

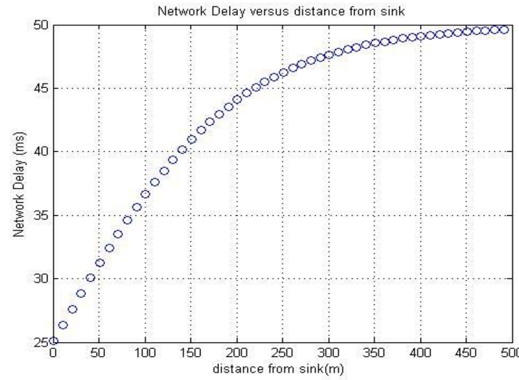

Fig.10 Network Delay versus distance from sink

The above figure depicts the variation of network delay with respect to the distance from the sink node. It can be seen that the network delay increases as the distance from the sink increases. This happens due to the fact that the data needs to be transmitted over multiple hops.

V. CONCLUSION

It can be concluded from the previous discussions that wireless sensor networks (WSNs) are mainly characterized by their limited and non-replenish able energy supply. Hence, the need for energy efficient infrastructure is becoming increasingly more important since it impacts upon the network operational lifetime. Sensor node clustering is one of the techniques that can expand the lifespan of the whole network through data aggregation at the cluster head. The proposed system employs PSO and optimized re-transmission. It can be observed from the results obtained that the parameters which are computed are residual energy of nodes as a function of number of iterations, one hop delay with respect to duty cycle, network delay with respect to the distance from the sink and network and energy consumption with respect to distance from sink node.

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