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ENHANCING THE LIFE TIME USING GAME THEORY APPROACH FOR WIRELESS SENSOR NETWORKS

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***Abstract*- In wireless sensor networks the key issues are energy efficiency and reliability. Due to the limited battery life, arises the problem of coverage and coordination in a network. The sensors near the sink have to process their loads and also the load from outer sensors. So they deplete their energy faster results in network failure. The proposed method, energy balanced model is used to balance the load among the sensors and to improve their sensing and routing efficiency. In order to make the sensors as intelligent rational decision makers the non cooperative game theory approach has been used. The resource management can be done by using Nash equilibrium in non cooperative game theory approach. The method of distributed power control is used to improve the total power efficiency. This method is carried out with the static nodes. The efficiency of each static node gets increased by using this algorithm and hence the efficiency of whole network gets improved. The simulation results are shown in NS2. This algorithm can provide better efficiency and improved quality of service.**

Keywords-Energy balanced model, Game theory. Lifetime maximization. Wireless sensor networks.

I. INTRODUCTION

The efficient sensing mechanism has been developed in the recent wireless communication is the wireless sensor network. As the sensors are intelligent entities to sense and process the data from the environment. There are two types of nodes present in the network as static and mobile node. There are two kinds of deployment schemes; in deterministic deployment, the sensors are arranged in sensing region in pre-calculated way and in random deployment the sensors are not placed in well calculated way [1]. Some assessment can be carried out before placing a sensor when the environment is supportive. An example of random deployment of sensor nodes would be in battlefield surveillance. In such a deployment, the most common way of extending the network lifetime is by scheduling the sensor nodes such that only a subset of sensor nodes that is enough to satisfy coverage requirement need to be active at a time. The load on each sensor get differ depend on their random placement in a network. The sensors near the sink have the problem as quick depletion of energy and connectivity In the WSN they have adhoc distribution of sensors which is capable to provide sensing, processing, communication among the network.

The sensor nodes which are present in wireless sensor network are capable to collect large amount of data from a network. In WSN the data sensed by static nodes are get forwarded towards sink which locates at the center of the network. Energy plays a major role in wireless sensor network. They are powered by small and inexpensive batteries need to survive for long time for different goals without recharging. When the sensor locates far away from the sink then amount of load to get process is less when compared to the sensor which present near the sink. So the energy depletion also get vary depend on their location and processing of load. Alippi [2], presents that in wireless sensor networks energy management is a critical task due to severely power limited sensors. The two factors which cause limitation of power are at first, when sensors operating at full intensity they consume lot of energy which are not able to support by small battery for long time period. Secondly due to the reserved nature of physical locations battery cannot be get refilled. Nodes stop their work when they deplete their energy completely. So the mission of a network cannot be achieved when a node is died. The routing protocols also play an important role in deciding the life time of a network.

The sensors near the sink have to carry large amount of data which includes load from outside sensor towards the sink which depletes the energy faster than those which present outside the area from sink, which results in reduction of lifetime of a sensor network. So the non uniform energy depletion in the network causes the problem in determining the lifetime of a network. The lifetime of a network gets over when battery power of critical nodes gets depleted. This causes the partition of network because efficient path in a network get drained faster than other paths in network. In a randomly distributed sensor network the major problems are coverage and connectivity. The degree of reliability should monitor in a region to guarantee the coverage in a network. The successful packet transmissions to the sink are getting measured to provide metric about connectivity in a network. At the same time optimized coverage for the region is required for quality of service.

The goal is to literally balance the total energy consumption of each sensor over a specified period of time. The sensing region is assumed to be in circular shape with R as radius. Further, also assume that data generated by each sensor in a sensing region follows binomial distribution and routed to the sink which is situated in the center of the region.

The game theory approach is used to make the sensors as optimized decision makers. Nodes are considered to be players in WSN. The players may be either co-operative or non co-operative in order to maximize the network lifetime. In this paper, the distributed allocation of resources is used. In non cooperative game theory, the players are capable to take decision independently. The individual players provide a dominant role to maximize the network benefit. As each player is get provided with a set of strategy which provides a way to take decision in an environment. The strategy is choose by players individually depend on the environment condition .The Nash equilibrium is gets used to achieve better performance. The purpose of power control algorithm for non-cooperative game is to achieve the largest utility by lowest power cost. The objective it is important to maintain a satisfactory coverage and connectivity in the sensing region.

This paper is organized as follows: Section II discuss about the related works, Section III describes about system model. In section IV the conclusion work is given.

II. RELATED WORK

A heuristic approach is employed in (3) to improve sensor-to-sink binding in multi-sink WSNs by adapting a Genetic Algorithm to balance the load among the various sinks. For the sensors that cannot directly reach a sink, the algorithm considers the various sensor-to-sink routes during its computation, and yields the best routes for the load balanced solution. The several simulations to measure the variance of remaining energy among sinks, the death of the first sinks, the standard deviation of the number of nodes among sinks, and the average energy remaining in nodes. The solution needs to get improve to support when a certain path dies and how would the sensors depend on it get divert their traffic.

Ducrocq(4), authors proposed a algorithm for clustering where sensor chooses the cluster head. The choosing process depends on the factors as remaining energy, density, node degree, etc. The efficient way to organize the sensor network is clustering. An opportunity is provided to each sensor by this algorithm to become a cluster head to balance the energy consumption among all the sensors. When compared to regular nodes cluster head drain its battery more quickly. At every hop towards cluster head data aggregation is performed. As BLAC, an original battery level aware clustering family of scheme which can be handled locally to provide scalability and better delivery ratio.

Ren (5), they design an Energy-Balanced Routing Protocol (EBRP) by combining essential and possible field in terms of depth, energy density, and residual energy. The goal of this basic approach is to force packets to move toward the sink through the dense energy area so as to protect the nodes with relatively low residual energy. To address the routing loop problem emerging in this basic algorithm, enhanced mechanisms are proposed to detect and eliminate loops. The basic algorithm and loop elimination mechanism are first validated through extensive simulation experiments. They proposed based on controlled transmission power. Finally, the integrated performance of the full potential-based energy-balanced routing algorithm is evaluated through numerous simulations. In a random deployed network running event-driven applications, the impact of the parameters on the performance is examined and guidelines for parameter settings are summarized. This experimental results show that there are significant improvements in energy balance, network lifetime, coverage ratio, and throughput as compared to the commonly used energy-efficient routing algorithm.

In a uniformly deployed data-gathering sensor network the lifetime is maximized, by balancing energy consumption [6]. They formulated the energy consumption balancing problem as an optimal transmitting data distribution problem by combining the ideas of corona-based network division and mixed- routing strategy together with data aggregation. They first proposed a localized zone-based routing scheme that guarantees balanced energy consumption among nodes within each corona.

In sensors the energy is processed in three areas as sensing, processing and communication of data. The essential condition is to maintain the optimal power level. It is necessary to improve the successful packet transmission by reducing the interference and collision. The utility function of sensors get differ by their specialization as sensing, routing or idling [7]. The study of game theory gets motivated for power control and rate control in wireless data [8]. The total powers get minimized by using distributive iterative power control algorithm. The coordination overhead has been reduced by using decentralized game theory mechanism [9].

The non cooperative game theory is used in the sensor networks, used to get the packets forward and punishes the misbehaving node [10] .The distributed allocation of resources is provided by using game theory, which provides independent decision making in sensors. The Nash equilibrium is used to provide the solution of the game to attain the probability of optimistic states between sleep and wakeup to improve energy efficiency [11].

III. PROPOSED SYSTEM

The energy balancing is one of the important tasks in an unpredicted topology. The analysis is performed by considering the sensing region as concentric rings around the sink. The load in the sensors near the sink gets overloaded in both conditions as the sensors are uniformly distributed or accumulated distribution. The load in the sensor gets calculated by amount of data in the region to the area of the region. The concentric circle is get decreased by small value δ from outside to inside.

The load in the sensors need to be get equalized by equalizing the area. The area of an annulus is calculated by multiplying height of load curve over annulus with the width of annulus. The rectangle of equal area is considered to equalize the load throughout the curve. By increasing the width along with increasing distance from origin the equal area can be achieved. The number of sensors in an annulus can be represented by annulus number. The variation in the sensing or transmission range of sensors in annulus can be achieved by changing the width of the annulus. So the area of annulus can be changed by either controlling the sensing or transmission range.

The algorithms as annulus formation, connectivity ensured routing and coverage preserved scheduling are strength of the proposed EBM to balance the load in a network.

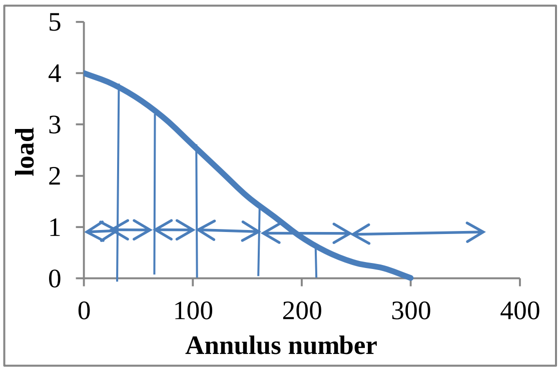


Fig 1.1 Equalizing load on the sensors

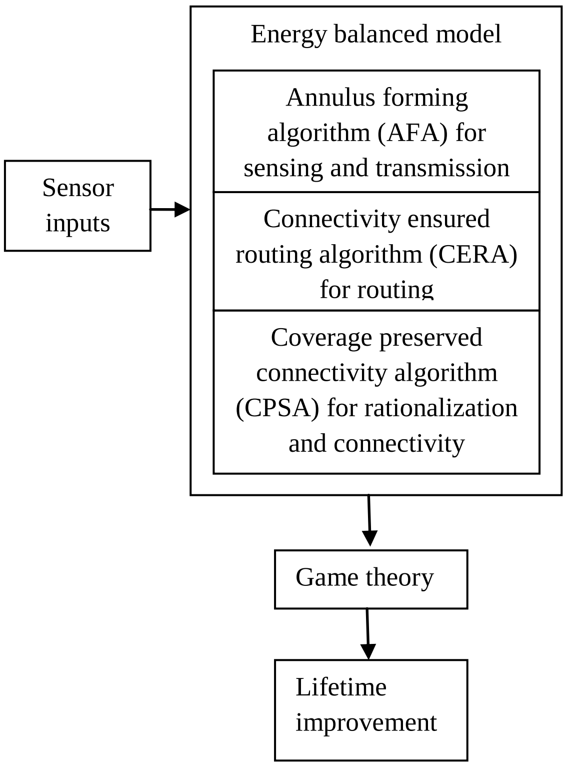
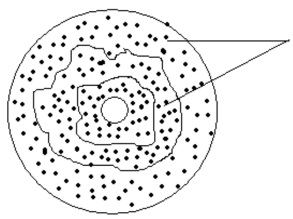


Fig 1.2 system architecture design

A. Annulus forming algorithm

In AFA the sink sends the hello packet to its neighboring sensors by which the hop count of sensors which receives the packet get increment its hop count value by one. This is the process by which annulus forming algorithm used and split the area of sensors from sink, depend on hop count value. They provide effective way for sensing and transmission.

The sensor stores the details to which it has sent the hello packets. This information is used in routing of the data packets. A sensor node compares the hop count and sends Hello packet if it has lower hop count than the previously received packet and remembers the packet that has lowest hop counts, i.e. hi . Each sensor node get finalize its annulus number from the previous phase of time sufficient to deliver a hello packet from sink to the farthest sensor node. The annulus formation is shown in Figure 1.3, where the area gets splitted depends on the hop count.



Annuli

Fig 1.3 Annulus Formations

Node id	Received power	Hop count	Annulus number

Fig 1.4: Field of a node of hello list

In Figure 1.4 the fields of a node of Hello list is depicted. Collision occurs while broadcasting the Hello packets by sensors. The sensor should have some random period of waiting time to avoid collisions before sending the Hello packet. The waiting time is inversely proportional to the hop count. i.e. the node having hello packet with minimum hop count should wait for minimum time. Density of sensors decreases from the inner to outer annulus. For routing the information is collected by exchange of hello packets. So no additional packets are essential for discovery of route. The transmission range variation in each annulus results in adjusting transmission power control in the formation of annulus. Therefore, the energy is consumed in transmission of Hello packets in annulus formation is the gain in energy in savings in terms of route discovery and transmission power control.

B. Connectivity ensured routing algorithm (cera)

The routing algorithm to recognize Energy balancing model by rationalization of energy consumption is proposed in CERA. From the Hello list each sensor chooses their next hop to deliver a packet using minimum number of hops. The sensor with highest residual energy is selected from the lower annulus is selected or from its own annulus for the rationalization of energy. While selecting next hop sensor from the Hello List, sensors from lower level annulus are preferred over sensors from same annulus. The packet gets being transmitted within the transmission range R_i with the identity of sensor which generates the packet and identity of the next hop. This CERA reduces the hop count when increasing in the number of sensors

C. Coverage preserved scheduling algorithm (cpsa)

The Coverage Preserved Scheduling Algorithm is presented for further rationalization of energy. The energy used in sensing region also needs to be rationalized. This algorithm sets off the surplus sensors for a specific period. Deploying large amount of sensors in a sensing region for providing satisfactory coverage results in redundancy. It's a hard assignment to classify the redundant sensors while preserving coverage. The relative coordinates system helps in identifying surplus sensors is proposed in this algorithm.

The sensor gets localized by using the relative coordinate of the sensor from the sink. The sleep and wake up state in the sensors get scheduled. As by finding the middle point between the sensors, when it get covered by atleast one neighboring sensor they are get considered to be redundant and make in to sleep state.

D. Game theory

The power control problem gets over come by using game theory which helps to provide the energy conservation. The non cooperative game theory approach gets used where the nodes are considered to be independent in decision making. The nodes are getting considered to be players in a game. Each player in a network should be capable to choose the best strategy from the strategy profile to make the network more efficient. The nodes in the game are rational where self interest property of each node is considered in choosing best strategy for transmission of power.

The non cooperative game theory includes three elements as,

1) The participants set can be given as $\Gamma = \{1, 2\ldots n\}$ where n nodes are transmitting in a network.
2) $s = \{s_1, s_2\ldots s_n\}$ as s_i is the strategy space for i the node.
3) Strategy profile $S = \{S_1, S_2\ldots S_N\}$, which are the strategies selected by all participants in order to improve the utility function of a network.

The cost of the utility function has been reduced by using the power control algorithm. In wireless sensor networks the air medium is used for transmission, while the each node acts as a source of interference for others. So the signal to interference noise ratio can act as a measure of quality of signal received. When minimum power is used for power transmission the energy efficiency is best but the transmission rate is low due to smaller SINR and interference ability. When nodes used maximum power for transmission then the efficiency will be low. So the non cooperative algorithm is used to adjust the transmission power range in order to achieve Nash equilibrium and get reduce the interference and improve the energy efficiency and transmission success rate.

The algorithm is get implemented to achieve high SINR with low power conservation. When the transmit power if fixed the SINR get improved which improves the net utility function of the network. The Nash equilibrium is used to obtain the solution which exists as a unique proof of the non cooperative game theory.

IV. CONCLUSION

The rationalization model for energy conservation is used in this paper. The effective mechanism to balance the load among the sensors and to make them to act intelligently and autonomous by using game theory approach is discussed. The malicious nodes get removed. By improving the coverage and connectivity in a network the transmission rate and efficiency can be improved. This approach helps in improving the life time of a network. The priority based approach has been used in future work to provide security for the network.

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