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Optimization of Energy by using IWD Algorithm in WSN

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Abstract: WSN (Wireless Sensor networks) is one of important wide spread networks that are effective in recent years because of the involvement of the network in terms of electronics, communication and information technology in the single network. Energy efficiency is the most required quality in a sensor network as each node consumes some energy with each transmission over the network. Energy optimization is required to improve the lifetime of network. In this paper, PEGASIS routing protocol is presented to optimize the energy by implementing IWD (Intelligent Water Drop) algorithm. This proposed IWD algorithm optimize its routing criteria by selecting the shortest path so that the energy which is involved inside the network can be optimized and thus increases the lifetime of wireless sensor network. Experimental results show that by using PEGASIS and IWD, energy consumption, throughput and packet overhead can be optimized.

Keywords: Wireless Sensor Networks, IWD (Intelligent Water Drop) algorithm, Energy Optimization, PEGASIS (Power Efficient Gathering in Sensor Information Systems)

I. INTRODUCTION

WSN (Wireless Sensor Network) is one of the busiest network on which large amount of different kind of data is communicated over the network. In, WSN (Wireless sensor network) sharing and processing of the information thousands of nodes could be done. And to enhance the efficient and scalability of the network operation the clusters are formed in which the sensors nodes are combined. A wireless sensor network is composed with vast number of tiny sensors. Each sensor node is defined with specific parameters like energy. After each communication in the network some energy is consumed. The type of energy in the network can be of different types such as solar, electronic energy etc. This kind of network requires the effectiveness of each kind of operation in terms of energy. More the energy will be wasted, lesser the network life will be. A network is the network of connected sensors defined in terms of radio frequency, range specification etc. Each device available these days having some sensor incorporated in it such as laptops, mobiles etc. Because of this it is the challenging advance area that requires feasibility in terms of memory, power consumption, memory management, security etc. The economic and the technological factors are also required to be analysed.

II. ARCHITECTURE OF WSN

In WSNs, the only source of life for the nodes is the battery. During Communication and sensing with nodes it requires energy to process the data and during transmission. Then the collected data is moved to sink. In some cases (e.g. surveillance applications) batteries which are low or drained of energy should not be replaced. So in this field many researches are trying to find some kind of solution so that by using some protocols and algorithms the energy efficiency problems can be solved as stated above. Figure 1 shows the architecture of a sensor node.

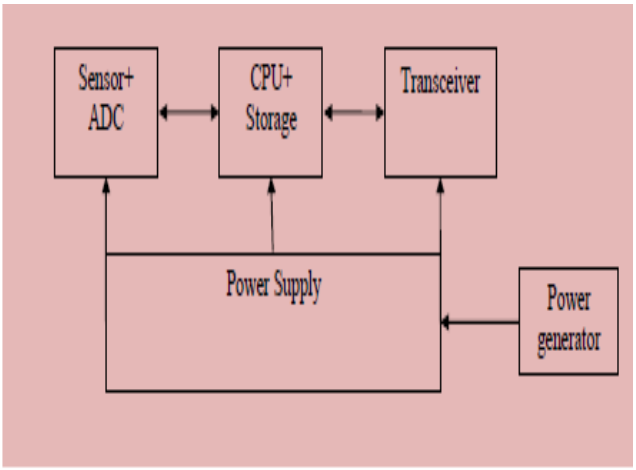

Fig 1: Architecture of a sensor node [2]

WSN (Wireless Sensor Network) consists of sensor nodes with capabilities of sensing, computing and communication. These are placed all over the physical world in such a way so that it can sense and gather the information which is desired. Few sink nodes collect all the data which is sensed by the sensor nodes to the network like internet which has accesses to infrastructural network as well. The end user can get the remote data by accessing the network. WSN (Wireless sensor network) consist of hundreds and thousands of nodes as per requirement which in further is connected to some sensors.

A. Components of WSN

WSN comprises of many components. They are:

a) **SN (Sensor Nodes)**: Sensor nodes are the most important component of a WSN (wireless sensor network). Sensor nodes play multiple roles in a wireless sensor network, like storing of data, sensing, processing of data and routing.

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Connectivity of sensor nodes in a WSN are shown in the figure 2.

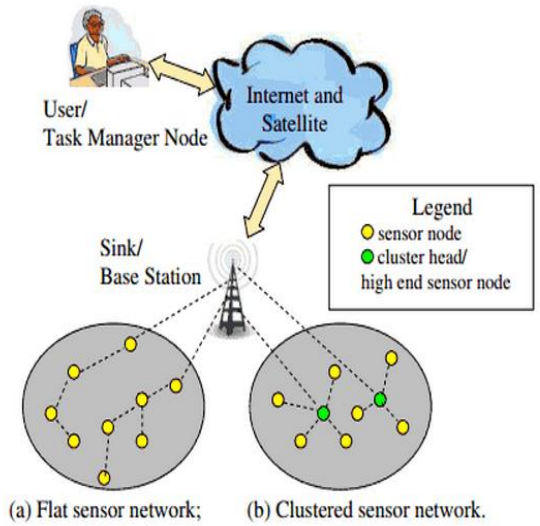

Fig 2: Connectivity of sensor nodes in WSN

b) **Cluster:** The organizational units of WSN are called clusters. Clusters are required as these helps to broke down the large and complex network so that the tasks like Communication and Sensing neighbor cluster heads and paths.

c) **Cluster head:** Cluster heads are the representative who acts as a leader of a cluster. They organize different sort of activities in-side the cluster. These tasks doesn't affect the process of organizing and scheduling the communication and data-collection of the cluster.

d) **BS (Base Station)**: In the hierarchical WSN (wireless sensor network) at the upper level base station is placed or it is there. It is helpful in providing a link of communication between the end user and sensor network.

e) **EU (End User)**: There is a wide range of applications where data in sensor network can be used. Therefore, by using different gadgets (e.g. PDA) even a laptop or desktop can be

B. Categories of WSN

WSN can be classified into two categories:

- Structured
- Unstructured.

The importance of a structured WSN is that few devices can be implemented with low network management and maintenance costs. An unstructured WSN contains a dense collection of sensor nodes, which are randomly placed into the field (i.e., deployed in an ad-hoc manner). When the environment is not directly accessible by humans there a WSN an ad-hoc type network is used as it consists of thousands of nodes to cover a large geographical area for e.g. war zone, nuclear accident area, deep sea, polar regions and various others regions where human can't reach. Target tackling and monitoring of the environment as a remote is an important application of WSN. As due to its availability, cost and intelligence it is in higher in interest. These sensors can communicate with each other through wireless interfaces as these were highly equipped.

III. RELATED STUDY

Eric Rozner et al. [8] presented a framework model for optimization has been developed by many researchers to optimize rate of both multicast and unicast traffics and their routes. A framework that is presented in this paper is different from other as the performance rate or the optimization derived is achievable in IEEE 802.11 network. S. M. Lambor et. al. [1] analyzed that as the lifetime of network is increased, the consumption of energy gets decreased with the increment in number of hops and minimum is attained at critical hops. Consumption of energy gets gradually increased after these critical hops because of consumption of cumulative energy increases in intermediate nodes. Fang Quen et. al. [2] compared and analysed four adhoc routing protocols which are: DSDV, DSR, AODV and OLSR (optimized link state routing) in NS2. Shiv Kumar Singh [3] proposed Homogenous Clustering Algorithm for improvement of energy consumption rate in wireless sensor networks. In this algorithm, firstly the sensor nodes are clustered and then to calculate the size of the clusters, and divided into round. At each round, the current cluster heads selects cluster member's node as the next cluster head. Che jung hsu et. al. [10] proposed an Opportunistic Routing (OR) protocol that is free from duplicate transmission. OR utilizes overheard packets and takes multiple routes into consideration concurrently. Onur Soysul et. al. [5] proposed sleep/wake-up protocol POWERNAP, Which detect the overhead of distributing complex information to the nodes. The pseudorandom generator encodes. And enables snooper/recipient to calculate its sleep/wake-up schedule from this seed POWERNAP delete the idle-listening problem and achieves low-latency, and low-cost of data packets for routing protocols. Addrian oerrig et. al. [15] an environment for security of building blocks is presented by the author so that the optimization of resources in environments and wireless communication can be done. Some protocols are applied in this paper and it has been shown that they can also be practically applied even on any hardware. Libo song et. al. [13] proposed a new routing that has shown that the delivery ratio and the routing protocol suffers from high resources usage or low delivery rates. Hence it can be said that a trade-off between resources usage and delivery rates is done by protocols.

IV. PROPOSED WORK

In this section, the proposed work for achieving optimization by using IWD (Intelligent Water Drop system) algorithm and PEGASIS as routing protocol is described. The flow process of the proposed work is shown in following figure 3.

Initialization of WSN parameters are firstly done in this research. The parameters taken are packet delivery ratio (pdr), jitter and throughput. Firstly nodes are taken which makes full scenario for WSN and then the pegasis protocol is used for the routing which discover the chain head.

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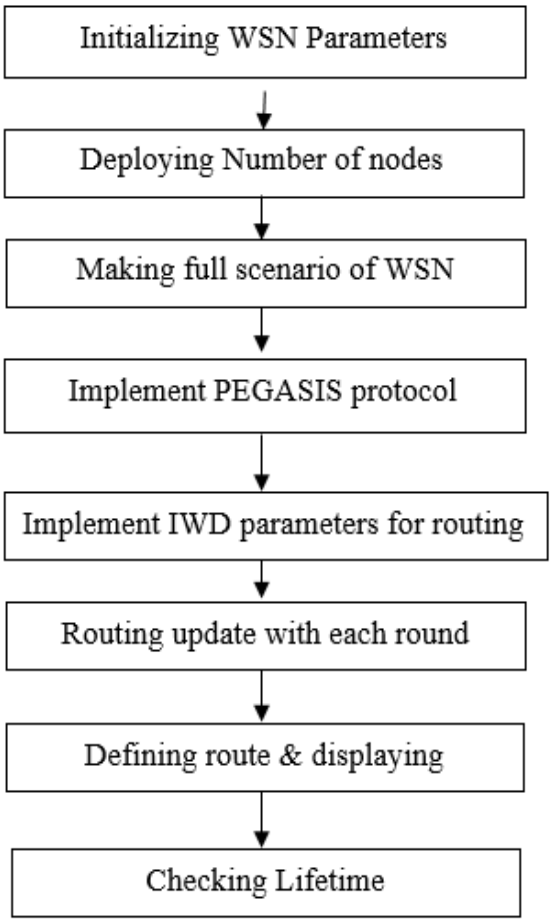

Fig 3: Process flow of proposed work

Implementation of IWD is done which update the routing after each round and giving the optimized route. In that way the life time of network is increased because it takes less energy as compare to others.

A. *PEGASIS routing protocol*

PEGASIS (Power Efficient Gathering in Sensor Information Systems) is the algorithm in which greedy method is use for chaining to optimize the energy consumption in the network. It is based on another protocol LEACH (scenario model and radio model of both are same).

PEGASIS mainly do two things:

a) Chaining among the nodes
b) Data fusion

In this any node can turn out to be a leader of the chain, where the chaining mechanism is done by using greedy algorithm which are implemented on the sensor nodes. PEGASIS considers that the sensor nodes are stationary and have the global or whole knowledge of the network. By stationary means no movements in the sensor nodes and each node have some local information about the local nodes.

Data fusion is performed in PEGASIS except the end nodes of the chain. As in LEACH the dynamic cluster formation is an overhead it is been eliminated by PEGASIS, and the sum of distance is also minimized so that non leader nodes now can transmit, the number of receiving's and transmissions are also minimized among all nodes. And after one round only one transmission is done to the base station. The problems by which LEACH and PEGASIS suffers are same. Scaling is not there in PEGASIS, it cannot be applied or used where the knowledge or global knowledge of network is not easily available.

As PEGASIS is the improvement over LEACH protocol. In this it doesn't perform multiple clustering beside that it(PEGASIS) perform chaining among the nodes so that each node can easily transfer and receive data or information from the neighbour node and out of all only one is selected as a cluster head which transfer it to the base station or sink. The chaining among the node is doing by using greedy method. It can be further understand like Node 'a0' passes data to 'a1'. 'a1' aggregates nodes a0 data with own and then the transmission of that data to the leader or cluster head is done. Node 'a2' do the same waiting process to get the data from the neighbour node and then after doing aggregation finally 'a2' sends a message to the sink or base station.

B. *Proposed IWD (Intelligent Water Drop) Algorithm for energy optimization*

Intelligent Water Drop (IWD) algorithm is a combination of two things. They are: A graph which is of great importance as it works as distributed memory on which the soils with different edges are preserved, and the other constituent of this IWD algorithm, is the aggregation of small number of drops call as intelligent water-drops. These Intelligent Water Drops (IWDs) cooperate as well as compete to find many available solutions and then replaces the paths of the soils of the graphs to find efficient solutions. IWD based algorithm needs at least two corresponding IWDs to work effectively.

Two kind of parameters are used in IWD algorithm. They are static parameters and dynamic parameters. When the parameters taken are static parameters they are defined as constant in the working of the IWD algorithm. While when parameters taken are dynamic, they need to be reinitialized after each iteration in working of IWD algorithm.

IWD works on following algorithm:

1. Firstly, initialization of static parameters of IWD are done. It involves following two steps:
   a) Representation of problem to be done in form of a graph
   b) Set value of all static parameters
2. Initialization of dynamic parameters of IWD are done. They are:
   a) Soil
   b) Velocity
3. Distribute or plot IWDs on the graph of problem.
4. Construct solutions using IWDs and also update soil and velocity parameters.
   a) Update local soil on the graphs.
   b) Update velocity and soil parameters on the IWD.

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5. On each IWD's solution, perform a local search (this step is optional).
6. Update global soils.
7. Update total best solution obtained.
8. Go to step 2 until a termination condition get satisfied.

V. EXPERIMENTAL RESULTS

All experiments in present research work are carried out on Ubuntu, a linux based operating system with Intel Core 2 Duo Processor 2.10 GHz with 2 GB RAM. Simulation tool NS2 (Network Simulator) is the tool that is used for implementation. Tcl (Tool Command Language) is the programming language used. NAM (Network Animation) is used to trace the packet data. Experimental results obtained by implementation of the proposed methodology for improving the lifetime of WSN are shown in form of following graphs. All performance parameters analysed are compared with an existing algorithm BIOSARP.

A comparison of hybrid BIOSARP algorithm with IWD for packet overhead in shown with the help of graph in figure 4 where red line shows the packet overhead for hybrid BIOSARP and green line shows the packet overhead for IWD.

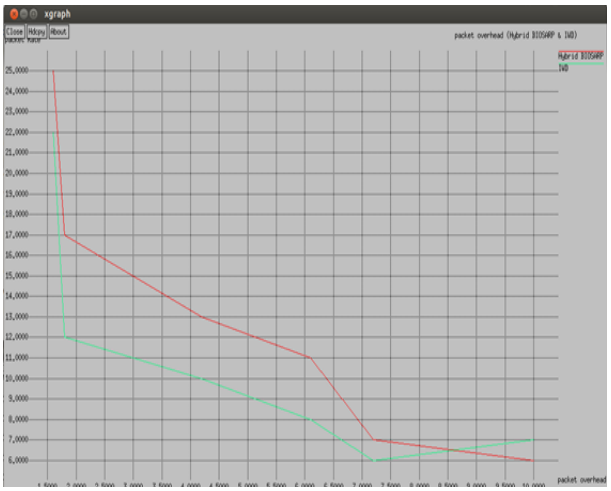

Fig 4: Comparison of packet overhead for hybrid BIOSARP & IWD

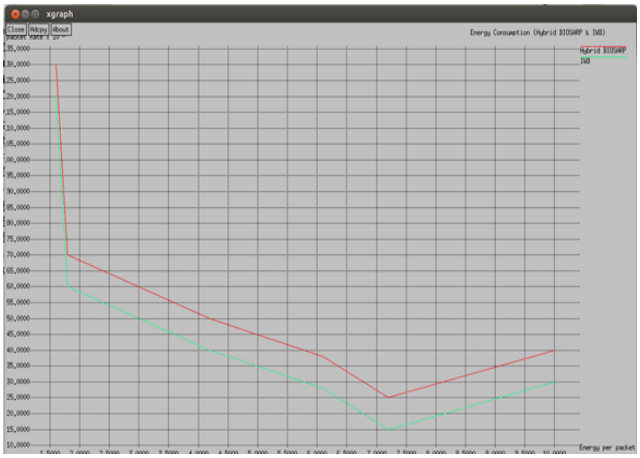

Fig 5: Comparison of energy consumption for hybrid BIOSARP & IWD

A comparison of hybrid BIOSARP algorithm with IWD for energy consumption in shown with the help of graph in figure 5 where red line shows the energy consumption for hybrid BIOSARP and green line shows the energy consumption for IWD. It can be seen energy consumption is lesser for the proposed IWD algorithm.

A comparison of hybrid BIOSARP algorithm with IWD for packet delivery ratio in shown with the help of graph in figure 6 where green line shows the packet delivery ratio for hybrid BIOSARP and red line shows the packet delivery ratio for IWD.

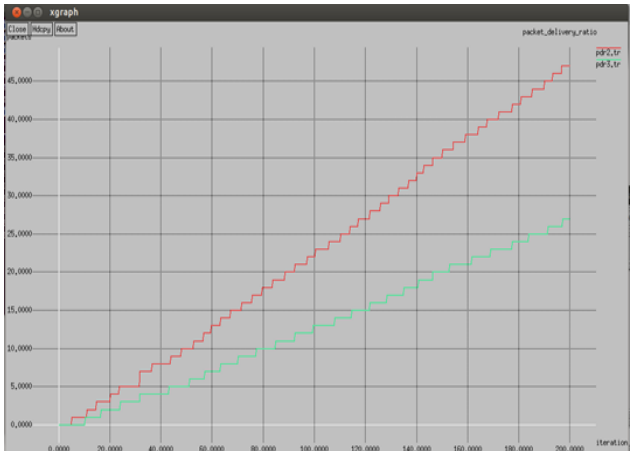

Fig 6: Comparison of packet delivery ratio for hybrid BIOSARP & IWD

VI. CONCLUSION AND FUTURE SCOPE

The main aim of this thesis is to increase the life time of the WSN by optimizing the route so that packet overhead, packet delivery rate and energy consumption gets optimized. In this thesis, PEGASIS is implemented to optimize the energy by using IWD (Intelligent Water Drop) algorithm. Experimental results show that by using PEGASIS and IWD energy consumption, throughput and packet overhead can be optimized. The present research work of optimization of energy using IWD can be extended by increasing the number of nodes in the network. There is a scope of further optimization of energy by introducing a hybrid algorithm that works on IWD algorithm in combination with other efficient algorithm.

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