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A Smart Energy Efficient Scheme for Dynamic Clustering in Wireless Sensor Network using Neural Networks

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Abstract: Wireless Sensor Networks (WSN) consists of large number of sensor nodes. The sensor nodes are battery powered devices, they communicate over a wireless medium and consumes energy during data transmission. In the past years various techniques have been proposed to reduce the battery consumption of wireless sensor networks. The previous approaches are based on the static clustering which follow the rules of LLC algorithm. In this paper, novel technique is been implemented which is based on the Dynamic clustering. The Cluster heads in each cluster have changed according to the network conditions. Dynamic clustering is being proposed in this paper which is based on the neural networks. The proposed technique is implemented in NS2 and simulation results show that novel technique will reduce network overhead and increase network lifetime.

Keywords: WSNs, Sensor nodes, Data Dissemination, Caching, Multisink.

Introduction: The wireless sensor network consists of large number of sensor nodes spread over the specific area wherever we want

to sense the environment conditions like temperature, pressure, motion etc. The wireless sensor nodes consist of the power management module, sensor, processor and transreceiver. Sink is used to inject queries into sensor field and sensor nodes are used to sense the event which is occurred into field and give responds of that query.

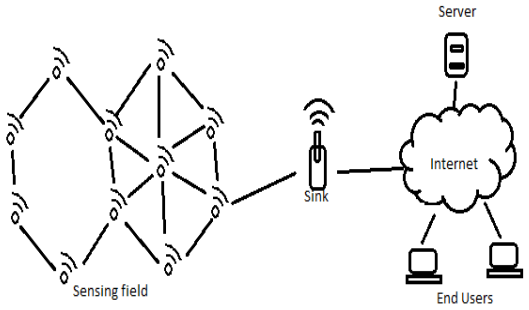

Fig 1: Wireless sensor network

The data collected by the sensor nodes are send to the sink, sink is the like the base station which broadcast the data collected by the sensor nodes to the internet. Sensor node consists of four units which act as sensing unit, processing unit, Transreceiver unit and power management unit. Sensor unit consists of sensor which is used to sense the changes in the environment, processing unit consists of ADC which convert analog signal to digital signal and storage, and transreceiver unit

consists of transmitter which is used to transfer the data to next node. These three units are connected with power unit.

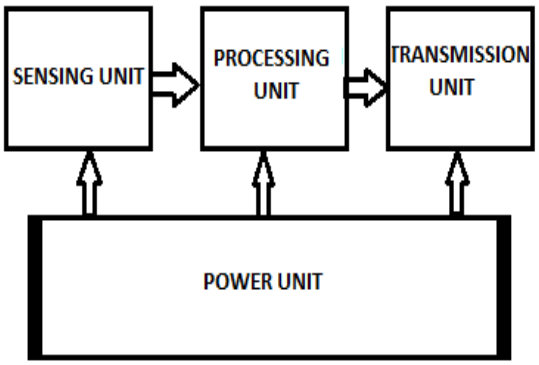

Fig 2: Architecture of sensor node

As, shown in the figure power management module interact with the processor, sensing unit and with the Timing sync module. The sensor nodes communicate with the sink through the radio waves without use of any wires. If the node is not able to communicate with other through direct link, i.e. they are out of coverage area of each other, the data can be send to the other node by using the nodes in between them. All the sensor nodes are battery driven devices so the power management unit is very important issue in the wireless sensor network. The sensor nodes are communicate through a wireless medium like radio frequencies, infrared or any other medium, which is having no wired connection. Node gathers the data and transfer to as sink. The sink may connect to the outside world through internet. Sink collects the data from SN, and transfer to the user who requested it. The sink may also be an individual user who needs the desired information. The main problem in WSN is limited battery life of sensor nodes. Data transmissions consume battery power so any optimization in these networks should focus on optimizing energy consumption. For communication the network is flooded with the route request packets by the source node, every node responded back to the source node with route reply packet .The source node select the shortest path ,shortest path means the path which is having the minimum number of hops. When the shortest path is selected between source node and the base station ,the selected path is fixed throughout the life time of the sensor node [12].

Related Work: Many techniques have been explored for the optimization of energy usage in wireless sensor networks. Routing is one of these areas in which attempts for efficient utilization of energy have been made. With the help of efficient routing the best path from source to sink is chosen which reduce the traffic from network and increase the overall lifetime of network [1].

In WSN sensor nodes deployed densely and uniformly in the sensing field, a mobile sink injected Query packet by the mobile sink and routed to the specific area moving through the sensing field. Then the corresponding Response packet is returned to the mobile sink via multi-hop communication. Due to the mobility of the sink, the Query and Response should have different routes which reduce the collision and traffic and power consumption [2].

Wireless sensor networks consist of large number of sensor nodes which collected information from different environmental phenomena and sending base station which is called Sink. The sensors are having some faults like maintaining the network in proper functionality. In this paper the proposed method for recovering lost packets by caching data in some of network nodes which is a combination of Extended NAC and Active Caching (AC) methods and we call it New Active Caching (NAC) [3].

Due to the limited energy resource, energy efficient operation of sensor nodes is a key issue in wireless sensor networks. In proposed cooperative caching scheme for wireless sensor networks, one-hop neighbour

of a sensor node form a cooperative cache zone and share the cached data with each other. It ensures sharing of data among various nodes reduces the number of communications over the wireless channels and thus enhances the overall lifetime of a wireless sensor network [4].

For improving WSN's energy efficiency that already uses an energy efficient data routing protocol the proposed improvements are (i) data negotiation in which active sensor send its sensed data only when the data changes, (ii) development of data change expectancy in which a sensor develops the expectancy of when its sensed data might change, and (iii) data vanishing, duplicate sensed data from multiple sensors are discarded while routed to the base station [5]. The battery resource of the sensor nodes should be managed efficiently, to increase network lifetime in wireless sensor networks, multiple sink nodes should be deployed with time constraint that states the minimum required operational time for the sensor network which increases the manageability and reduces the energy consumption of each node [6].

Routing Protocols: In this section, we briefly overview four popular routing protocols for wireless sensor networks.

MultiHopRouter: MultiHop Router is used for shortest path-first algorithm with a single destination. The main module consists of MultiHopEngineM and MultiHopLEPSM, which are connected to TinyOS system components such as Queued Send, GenericCommPromiscuous, TimerC, and other components. It provides the application interfaces such as Send, Receive, Intercept, and Snoop for user application.

TinyAODV: it's version of AODV (Ad hoc On-Demand Distance Vector) designed specifically for wireless sensor network. it find route only when it is needed. Three main components for TinyAODV are AODV Core, AODV PacketForwarder, and SingleHopManager. The main routing functions are provided by AODV_Core and AODV_PacketForwarder. SingleHopManager provides interfaces such as SendMsg, ReceiveMsg, Payload and others.

GF: GF (Greedy Forwarding) is a geographic routing protocol. The packet is transmitted to the neighbor of the sender that is closest to the destination. A beacon message is broadcasted every five seconds[11]. The neighboring nodes receive the beacon message and then add the sender node id and related information to the routing table. If the neighbors have not received the beacon message for a period of time, then the entry in the table will be removed. This ensures that only the freshest neighbours with good links are used to forward packets to the destination. GF consists of two main modules Neighbour List and GFForwarder, NeighbourList builds the routing table, and GFForwarder forwards the packet from source to destination.

GF-RSSI: GF-RSSI (Greedy Forwarding with Received Signal Strength indication) uses signal strength as one of the link estimator. If the sender finds a neighbor node closest to the destination and the signal strength from that neighbor is above a certain threshold, then it will forward that data to that node. Otherwise, the sender will search for another neighbour, who has a better link quality indication. GF-RSSI was designed to overcome a drawback of GF. The drawback comes from the routing algorithm: GF always chooses next hop based on shortest path to destination. In special situations such as in densely-populated network or indoor network, the greedy algorithm often performs poorly because communication paths frequently become unreliable due to interference by neighbouring communications. Therefore, the shortest path is not the best choice in that situation [13].

Dynamic Clustering

Dynamic clustering is an energy efficient algorithm. Energy dissipation of the network can be reduced by using clustering algorithms. The energy consumption of wireless nodes is depends upon the transmission distance, optimal routing protocols and amount of data to be transmitted. In cluster based wireless sensor networks, cluster heads (CH) meets these requirements 1) same adjacent sensors are grouped into a cluster. 2) High energy resources 3) Network should be distributed. Low Energy Adaptive Clustering Hierarchy (LEACH) gives a simple distributed clustering scheme for evenly distributing energy. dissipation[12]. Probability function is used to rotate the position of the CHs. Optimal energy dissipation is not considered by LEACH at each round. CHs are never distributed in LEACH [15].the main aim of dynamic clustering technique is to assign data set patterns to the cluster. Cluster member nodes leads low level hierarchal,CH leads high level and cluster formation leads two level hierarchies. The sensor nodes transmit its data to CH nodes periodically.CH nodes aggregate that data and send to base station either directly, through intermediate or through some other CH nodes.CH nodes spend a lot of energy at higher rates to send data to higher distance or same distance. A periodically re-elect new CH is the solution to balance the energy consumption among the nodes in each cluster. Single hop intracluster and multihop intercluster is its example. Base station received data from sensor nodes and which is further accessed by end users.CH is the sink for cluster nodes and BS is sink for CH [5]. A high power of energy is acquitted by the sensors[8]. Clustering of nodes shows that network is more stable and efficient. Clustering of nodes is based upon least distance and higher energy by knowing location. Clustering reduces traffic network and increase performance. Deployment of an intelligent energy efficient for cluster based upon WSNs is introduced, in which the node of sensors decides to join a cluster in peer to peer mode to represent energy level [3]. Through other cluster heads CH forward data to sensor nodes [5].

A cluster member has no communication with sensor nodes but has direct communication with

cluster head. There is single hop communication between a node and the CH and multihop communication with base station and cluster head. Centroid method is used to find the Cluster mean. The least distance between the Cluster mean and the Cluster member is select as a Cluster head. Hierarchical clustering is particularly useful for applications that require scalability to hundreds or thousands of nodes [9]. To maximize the battery lifetime dynamic clustering offers flexibility [15].

Proposed Technique

In this work our main concern is reclustering the grids using neural networks. In the present work clustering of grids is static but in our work clustering of grids is dynamic. It can be adjustable and changeable according to the situation. In this node data which is send can be easily adjustable according to the situation and calculation made on the basis of battery consumption. Here main concern is to avoid battery wastage. The cluster head is also choosing according to the minimum battery consumption by applying election algorithm. Suppose we have a network in which number of batteries are placed. Each battery has the data send capacity in milliampere. We consider that we have number of batteries available and each battery further forward data from source to destination. AODV algorithm is used in it. We have three clusters in which we have three cluster heads present. Cluster heads choose according to the maximum sending capacity and minimum battery consumption. The battery which satisfies both the above mentioned technique that will be head of that cluster. We assume that we have three batteries which have the capacity of sending data capacity of 8 milliampere,10 milliampere and 12milliampere respectively in a cluster. Now we have to choose cluster head which send full data after that become dead. If we choose 12 milliampere battery as a cluster head then it will send our data successfully but cannot be sufficient for another data packet transmission after it. So wastage is there. If 10 milliampere will be choosing then there is also wastage of 2milliampere battery. This battery cannot be used in the transmission of another data packet. We choose battery of 8 milliampere capacity as a cluster head; it can be send data fully without any wastage. Again to choose the best path of those batteries which waste minimum battery and minimum hop count also kept in mind to choose the best route or path. After the transmission of the data, battery will die then reclustering of grids again starts [12].

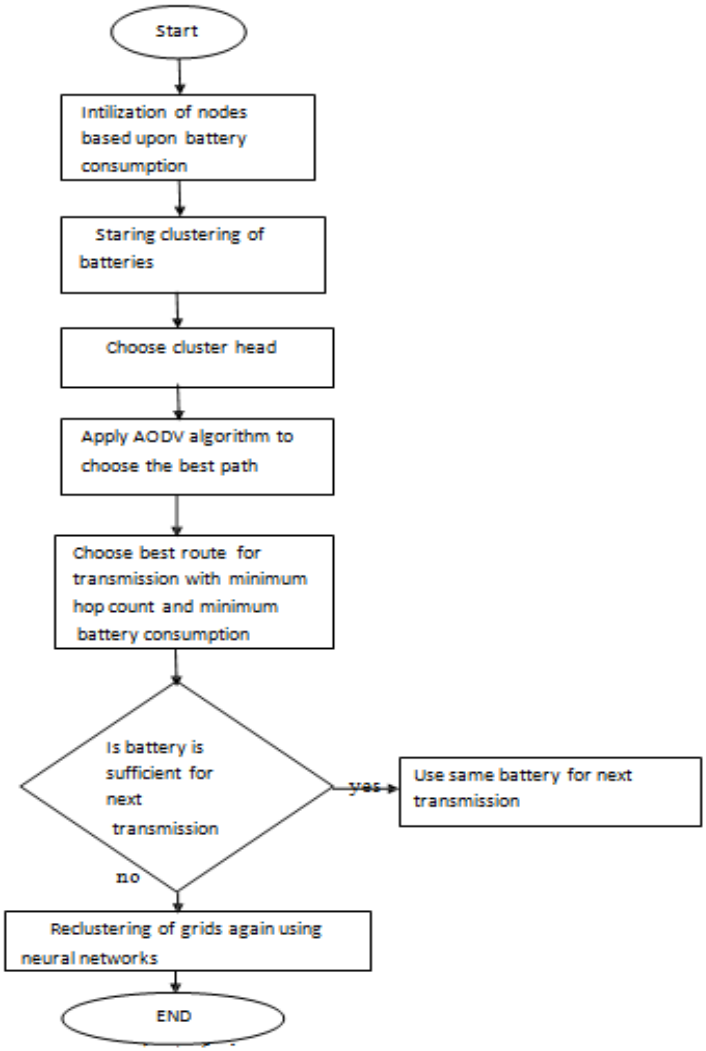

Fig 1: Flow Chart of Proposed Technique

Results

The Proposed technique is implemented in network simulator version 2. The NS2 is the event based simulator. The results are shown graphically in the figure 1 and figure 2

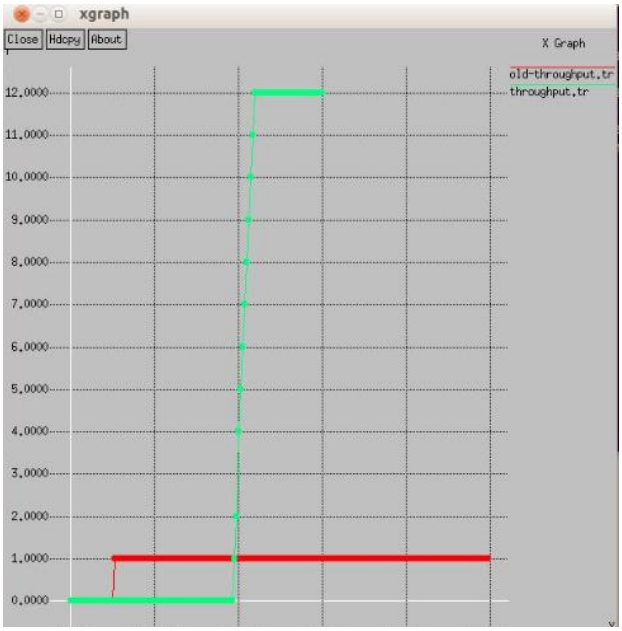

Fig 1: Throughput Graph

As shown in figure 1, here in the throughput graph, as the number of packets increases throughput also increases as compared to old scenario in which throughput is less. Red line shows old throughput and green line shows new throughput.

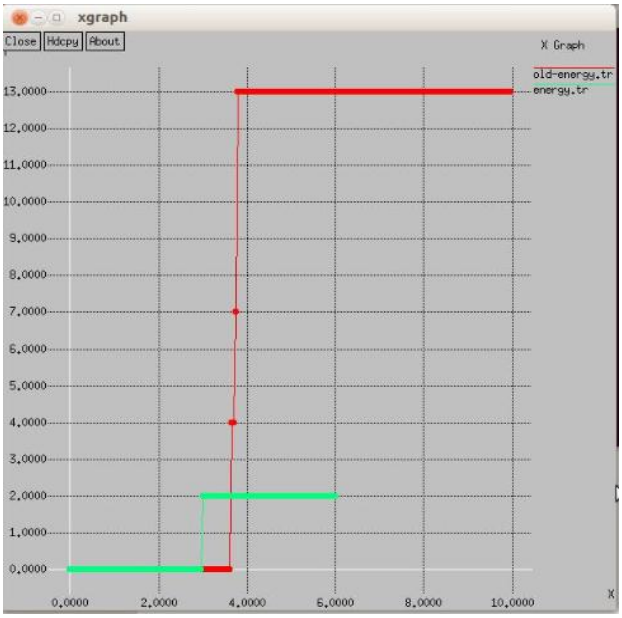

Fig 2: Energy Graph

As shown in figure 2, In this scenario calculate the energy that come in old and new scenario. In first case energy consumption is more .but in the second case energy consumption is less.

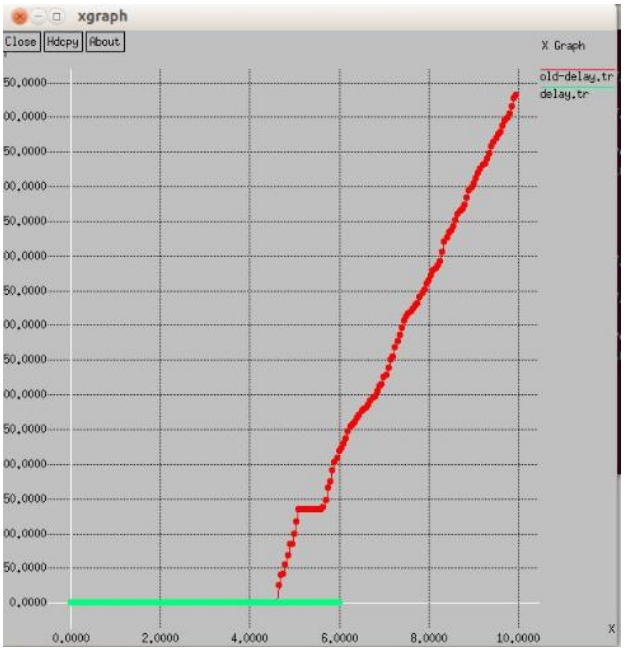

Fig. 3 Delay Graph

As shown in figure 3, Red line shows old delay and green line shows new delay. It illustrate that with new proposed scheme delay reduce as compare to existing technique.

Conclusions:

In this paper, novel technique is being proposed which is based on neural network. To reduce the overhead in dynamic clustering and to increase lifetime of the sensor network, cluster heads are changed using the approach of neural network. The proposed technique is implemented in Ns2 and simulation results shows that novel technique increase network throughput and network lifetime

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