# Energy Efficiency and Latency Improving In Wireless Sensor Networks

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Abstract: The wireless sensor is widely used in different areas now a days. So in order to use the best quality sensor we need to overcome the main problems of sensor .In order to work properly and make the best use of sensor , it is required to monitor the situation continuously with the sensors. It need more energy consumption of the sensor nodes. The energy requirement may increase when delay in data processing and it's communication from one node to other is more. In most of the cases it is difficult to replace the battery of a sensor node, after the deployment of node in the network. The energy and low latency play important role in such applications as they affect the life of network. Protocols are suggest by various researchers for energy efficient data process and minimum latency in sensor networks. Here we are try to overcome the problems of sensor by using new protocol. In this paper, a concept of distance metric based routing protocol approach is explored it will help to find shortest path selection and help to overcome latency problems. The proposed new protocol is 'dynamic energy efficient latency improving protocol .The results are compared with 'aodv' routing protocol. By using the new protocol the problem like network traffic is reduced and it also help to improve energy efficiency and latency of wireless sensor.

Keywords: Wireless sensor network(wsn),dynamic energy efficiency latency improving protocol

#### 1. Introduction

Mobile computing is define as availability of mobile service and information anywhere at any time .Generic term used to refer to a variety of devices that allow people to access data and information from where ever they are. Its humancomputer interaction by which a computer is expected to be transported during normal usage. Mobile computing involves mobile communication, mobile hardware, and mobile software Nowadays, Wireless Sensor Network (WSN) has become essential in almost all applications of monitoring or control, due to its many advantages. The 'WSN' is one of the important persistent networks which sense the environmental situation through various sensing parameters. The WSN is made up of thousands of sensor nodes including source node, sink node and base station to communicate with the outside world. Every sensor node has limited range transceiver, low power embedded processor, small memory and limited battery. In WSN, all sensor nodes are battery operated, and these batteries are nonrechargeable. In most of the applications, due to complicated deployment of sensor nodes, it is difficult to replace the battery. An energy efficient operation of the 'WSN' is very necessary for continuous monitoring application and prolong lifetime of the network. Also, it is obligatory to have modest processing time to avoid delay in sensitive applications like Industrial control, disaster monitoring, military surveillance and remote patient monitoring, etc. For energy efficiency and low latency in the sensor networks 'Tree' based and 'Cluster' based approaches are commonly used. In this paper, we have discussed a cluster based approach. In most of the clustering algorithms proposed for WSN, the main goal was low latency, energy efficiency and stability. The new protocol 'DEELIP' proposed in this paper is found suitable and convenient for this purpose.

is required to monitor the situation continuously with the sensors. The continuous monitoring operation results in more energy consumption of the sensor nodes. If the delay in data processing and it's communication from one node to other is more, then energy requirement may increase. In most of the situations, it is difficult to replace the battery of a sensor node, after the deployment of node in the network. The efficient energy management and low latency are the important issue in such applications as they affect the life of network. Many protocols are suggested by various researchers for energy efficient data process and minimum latency in sensor networks. There are limitations in existing protocols as they are particularly designed either for energy efficiency or minimum latency.

"An Approach to Increase the Wireless Sensor Network Lifetime "The LEACH routing protocol is developed by Dr. Wendi Rabnir Heinzelman, which uses the clustering and clustering task is rotated in the LEACH and cluster heads are selected randomly. LEACH is based on aggregation technique that combines or aggregates the original data into a smaller size of data that carry only meaningful information to all individual sensors. LEACH divides the wireless sensor network into several clusters. Each cluster has a cluster head that aggregate the data from the cluster nodes and process the data and transmit it to the base station. LEACH uses a randomize rotation of high-energy CH position rather than selecting in fix manner, so that a chance can be given to the every node to become cluster head and avoid the battery depletion of an individual sensor and die quickly as in direct communication, in which the node near to the base station depletes energy more quickly. The numbers of cluster heads and cluster members generated by LEACH are important parameters for achieving better performance. The cluster head makes a Time Division Multiple Access (TDMA) schedule for the nodes under its cluster. The communication between different clusters is done through CHs in a Code Division Multiple Access (CDMA) way. The cluster heads collect the data from their clusters and aggregate it before

# 2. Related Work

In delay sensitive applications of wireless sensor network, it

Volume 4 Issue 5, May 2015 www.ijsr.net sending it to the other CHs or base station (BS). After a predetermined time lapse, the cluster formation step is repeated so that different nodes are given a chance to become CHs and energy consumption is thus uniformly distributed. This protocol works mainly in rounds

- (1) Advertisement Phase
- (2) Cluster Set-up Phase

Each node decides independent of other nodes if it will become a CH or not. In the following advertisement phase, the CHs inform their neighborhood nodes with an advertisement packet that they become the cluster heads, than non-cluster head nodes receives the advertisement packet with the strongest received signal strength. In the next cluster setup phase, the non-cluster head nodes inform the cluster head that they become a member to that cluster with the "join packet" contains their IDs using CSMA. After the cluster-setup sub phase, the cluster head knows the number of member nodes joined the cluster and their IDs. On the basis of received message within the cluster, the CH creates a TDMA schedule, takes a CSMA code randomly, and broadcast the TDMA table to cluster members. After the set up phase, the steady-state phase starts. Data transmission begins; Nodes send their data during their allocated TDMA slot to the CH. The transmission using the TDMA schedule uses a minimal amount of energy (chosen based on the received strength of the CH advertisement). The transceiver of each non-CH node can be turned off until the nodes allocated TDMA slot, to minimize the energy dissipation in nodes. When the complete data has been received, the cluster head aggregate these data and send it to the BS. LEACH is capable to perform the local aggregation of data in each cluster to reduce the amount of data that transmitted to the base station. LEACH protocol performs in a good way; still it suffers from many drawbacks such like:

- It can't cover a large area.
- Cluster-Head selection is randomly, that does not take into account energy consumption.
- Cluster-Heads are non-uniformly distributed, where Cluster-Heads can be located at the edges of the cluster.

Ali Kashif Bashir et al.have proposed an energy efficient in network RFID Data Filtering Scheme(EFID) that divides the node into clusters. Every cluster head will check the data and after filter it send it towards the base station .The Intercluster data is being filtered at sensor neighboring nodes along the route. For this ,they use a clustering mechanism where cluster heads eliminate duplicate data and forward filtered data towards the base station. The main problem of this method is that the node cannot eliminate the all duplication by itself.

" SVM BASED DATA REDUNDANCY ELIMINATION " method is used aggregation tree is build for the given size of the given network. Then, to reduce redundant data SVM method is applied on the tree . Locality Sensitive Hashing (LSH) is used to minimize the data redundancy and to eliminate the false data based on similarity[18,19]. During each session, the LSH code is generated on the latest data readings of sensor nodes. The size of LSH code b is very small compared to the data size of last m readings. The LSH codes are sent to the aggregation supervisor node. Aggregation supervisor maintains redundancy count for similar LSH code. The aggregation supervisor finds sensor nodes that have same data and selects only one sensor node among them to send actual data. Aggregation supervisor also eliminates the outliers and it did not accept the data sent from any other other than selected node. The benefit of this approach is that it minimizes the redundancy and eliminate the false data, thus improving the overall performance of the WSN.

## 3. Problem Identification

The WSN is made up of thousands of sensor nodes including source node, sink node and base station to communicate with the outside world. Every sensor node has limited range transceiver, low power embedded processor, small memory and limited battery. In WSN, all sensor nodes are battery operated, and these batteries are non-rechargeable. In most of the applications, due to complicated deployment of sensor nodes, it is difficult to replace the battery. An energy efficient operation of the "WSN" is very necessary for continuous monitoring application and prolong lifetime of the network. Also, it is obligatory to have modest processing time to avoid delay in sensitive applications like Industrial control, disaster monitoring, military surveillance and remote patient monitoring, etc. Main problem that we focus on this paper are Low power embedded processor, Small memory and limited battery, Impact of simply forwarding Data from sensor.

# 4. Proposed Model

In WSN, when any node sends data through link, it has to find optimise routing path for data transmission so as to achieve low latency and high energy efficiency. In existing routing protocol, like 'AODV', if any node wants to send data from the source node to sink node then that sensor node broadcast 'route request message' to all free nodes so as to find the shortest path. The path length is based on the number of hop count only. If the hop count in particular route is more, then that may have a long path. Even for same hop count the distance between nodes may vary for different paths. The total delay depends on the number of hop count and distance of the path. This is the In WSN, when any node sends data through link, it has to find optimise routing path for data transmission so as to achieve low latency and high energy efficiency. In existing routing protocol, like 'AODV', if any node wants to send data from the source node to sink node then that sensor node broadcast 'route request message' to all free nodes so as to find the shortest path. The path length is based on the number of hop count only. If the hop count in particular route is more, then that may have a long path. Even for same hop count the distance between nodes may vary for different paths. The total delay depends on the number of hop count and distance of the path.



This is the drawback of 'AODV' for delay sensitive applications [1]. In proposed protocol, to reduce the transmission delay we have considered a new concept of the 'Distance Metric' (DM) instead of 'hop count (h)'. Here, the distance means the air distance between sink to particular sensor node. We have assumed that the sensors are randomly deployed on the field, so that the data transmission between any nodes to sink node may take several paths with different distance level since the distances between nodes are not equal. The total path distances from sensor nodes to sink node are calculated by adding all distances between nodes in that routing path. Actual data transferred only confirming the shortest path. Since the path is the shortest, the transmission time can reduce and so that delay can be minimize In this way with all possible combination of path distance, 'Distance Metric' is obtained. For example, one node to other node communication, which may be some hops away from each other, then every hop will represent, some distance between each hop. All that distance series will form a distance metric for that link. It is proposed that, the entire area is divided into the number of hops, starting from sink node. Each node in Nth hop level acts as a parent node for the (N+1)th hops level. Each node identifies or chooses parent node based on the least distance from that node to the parent node and parent node to sink. For the node, who is near to the sink, by drawing a line or by forming any hierarchy structure from the sink to down all sensor nodes, if the path is zigzag then the distance from the sink will increased. If it is straight link, then it will be the shortest distance between them. This is the concept to minimise transmission delay in the network. Since the deployment is random, various path combinations have to find out. All the distance values of path combination will form a distance metrics. The area considered here is 250 X 250 meters. All nodes in this scenario are considered to be randomly deployed. Announcement message is broadcasted 'only

once' throughout the network from the main sink node to establish all the connection, this is the basic principle used in designing of protocol. After the connection is established, all the nodes update their routing table in sink node. Since all nodes sends the message at a time and updates their routing tables at a time, it reduces the transmission delay. This is the main advantages of this protocol as compared with AODV. Broadcast information contains the location information of sink node so, the node receives the messages to find the distance between sink to that particular node. They also assign the hop level information and forward it to another node. This automatically updates the routing information, which helps to find the shortest path and reduces broadcast time which results in, reducing overhead on total network. The proposed 'DEELIP' protocol is developed on this concept. Routing tables of each node is upgraded simultaneously which results in reduction of unwanted overload in network. The processing time and transmission time are depend on queue length of traffic load. In AODV, the number of request routing message is equal to the number of nodes. All the sensor nodes send the route acknowledge message. As number of nodes increases, messages also increases taking more time. In this concept since sink node broadcast only once, it may save the time so transmission delay will be reduces. At the first level node, which is near to the sink node sends, broadcast message, will fix the hop distance, exact 250 meter, for leveling nodes. The transmission range of every node is assumed as 250 meter. In Proposed 'DEELIP' protocol, any sink to the other node for hop level parameter, it calculates the distance between nodes and also updates the distance between the sink to that node. So that sink node sent their recent position in announcement message to all nodes. At hop level one, it will update this between sink to their node, so the sink node has to send their recent one position in our announcement message. This method finally results in low transmission delay. This is the innovative way of reducing overheads on packet traffic so as to finally minimize the transmission delay.

#### 5. Existing Clustering Algorithms

In the WSN, the most basic operation is to transmit data packets from one source to other destination successfully. When data is forwarded, destination address of relay node is used from the routing table. The destination address in the Routing protocols is classified as Unicast Routing Protocol and Multicast Routing Protocol [5]. Both these protocols have three subcategories, i.e. proactive, reactive and hybrid routing protocols. In Proactive routing, routes are available immediately. In Reactive routing, protocol has to discover the route when needed. Hybrid routing is the combination of both. In the unicast routing source node [6] is send a separate copy of the address. At the sender node data packet is replicated and then each destination node receives this. Because of this process bandwidth is consumed by redundant data packets. The selection of protocol depends on the type of applications. In most of the applications routing protocols has to be studied based on geographical area. In this approach, the nodes in particular geographical area are combined to form a cluster. The protocols in this category are SPAN and PANEL. In SPAN protocol, every node is elected as the coordinator node if its neighbors are

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not connected with each other. If the neighboring nodes can be connected without it assistance then that node is withdrawn from its responsibilities. The cost of communication will be the same for all nodes in the same grid. During the routing decision when any particular node from any grid wakes up and takes part in routing then all other nodes will go to the sleeping state to avoid energy consumption. Routing activities are control by the coordinator nodes. The drawback of this method is the coordinator node will drain its energy quickly since it follows geographical based clustering [7]. In another protocol, Position based aggregator node election; PANEL, the sensor area is divided into fixed equal sized rectangular area. The node which is close to the reference point is selected as the aggregator node for that round. At the end of aggregator election procedure, all other nodes decide the shortest path up to the aggregator node for intra cluster data communication [8]. The aggregations done at Cluster Head (CH) level are known as Local Aggregation (LA) and the aggregations which are done at special nodes called as Master Aggregations (MA). Number of clustering methods are available and they their strengths and weakness. In this paper we have suggested some modifications in the existing clustering techniques to improve the performance. The hop count approach with distance metric is proposed. There is no specific rule for network topology and the user can define it, as per application, therefore every new clustering method may have its own strengths and limitations. The main concentration is given on latency improvement and energy efficiency is given in this work. Formation of clusters for every hop levels and routing information updating in a single stroke is the main key feature in this method. This reduces transmission delay and ultimately improves the energy efficiency [9]. Some assumptions made in this algorithm are as follows,

- All the sensor nodes are static during data collection process.
- All nodes possess the same ratings of transmission power, processing power and storage capacity.
- The geographical positions of node (X, Y) are known through GPS technique

If geographical positions are known then the aerial distance (d) between any two nodes can be estimated by using well-known

Euclidean distance expression,

$$a^{2} = \sqrt{(x_{1} - x_{2})^{2} + (y_{1} - y_{2})^{2}}$$

The transmission energy (Etx) can be calculated as, Etx = Eele + KBd .....(2)

Where 'Eele' is Electronics Energy, 'K' is constant (generally 100 pJ/bits/m2). 'd' is the distance between node and ' $\Box$ ' is the path loss component. The whole area is divided into clusters by hop levels. For every Nth hop level nodes, (N-1)th level node works as a parent node. Once the cluster head node is selected, it generates transmission schedule using TDMA technique and broadcast to its entire node [11]. The shortest path multi-hop data transmission is takes place, in order to reduce the further energy

consumption. Following steps are involve in data transmission,

- To prepare the routing table using distance metric, from the distance information between nodes.
- To find the shortest path between clusters of all hop levels.
- To update routing information at all node as per shortest path.
- To forward the aggregated information to the sink node.

If the cluster head from two nearby layers are assume to be 'a' and 'b', then 'Cost (a, b)', will represent the cost between  $\langle a,b \rangle$  in cluster node link as shown in equation 3.

$$\underbrace{\text{Cost}(a,b)=\underline{W}}_{\text{LK}(a,b)} \times \underbrace{\frac{\text{Ebinitial}}_{\text{Ebcurrent}}}_{\dots (3).}$$

Where 'W' is the data power required to send one bit by the node 'a', and LK (a, b) is the link quality between 'a' and 'b'. [12]. The process of inter-cluster routing involves three steps, i]The source node broadcasts a message, builds the path between neighboring nodes and sends information of source / destination

address, number of hops, energy level etc. ii] The receiving node 'b' computes the cost of establish link. iii]Then forward probability is calculated by node 'a' for each of the next hop and updates routing table, as shown in equation 4.

$$P_{a,b} = \frac{1/cost(a,b)}{\sum WD(a)/cost(a,w)}$$
....(4)

Where 'D (a)' is the next hop neighbour cluster head nodes.

Node calculate the new cost 'Cost (a, D)' and the number of hops 'ha' from himself to the sink node by the transmit probability as shown in equations 5& 6.

$$Cost(a,D) = \sum waD(a)Pa(w)Costa,w \dots (5)$$
$$h_0 = \sum waD(a)Pa,whw + 1 \dots (6).$$

Once the path is established, every route node of that cluster updates its routing table, which consists of the cost and the number of hops from every next hop to D. Proposed protocol

Has following strengths,

• Cluster efficiency is improved.

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- Higher scalability compared with the other methods.
- Clusters are formed using distance metric and transmission energy.
- Aggregation reduces the redundancy.

#### Advantages/ Disadvantages

#### Advantages

- 1) Performance improve
- 2) Over come energy and latency problem

#### Disadvantages

Making of distance matrix is important if any mistake in the calculation working have negative impact

## 6. Future Scope

The WSN is one of the important persistent networks which sense the environmental situation through various sensing parameters .Our proposed scheme, it can reduce the problem overhead in the sensor. To increase the merits of our research work, we plan to investigate the following issues in our future research

- In the future, this protocol can be physically deployed in indigenous low cost sensor node for Industrial control applications.
- In the future, we want to predict a model that helps to get the minimum threshold for a particular area

# 7. Conclusion

In this paper, the detailed study about existing clustering algorithms in the wireless sensor networks have been presented and a new algorithm which focuses on energy efficient data transmission between all the source nodes and the sink node. The new concept of 'Distance Metric' mechanism, in proposed routing protocol for dynamic energy efficiency and shortest path for the data transmission is found to be highly advantageous. If compared with AODV, the results are far better in the proposed routing protocol 'DEELIP'. It provides very low end to end delay and efficient battery utilization. It is the outstanding achievement of this research work. These results are very much useful to design engineers, those who wants deploy wireless sensor network for delay sensitive industrial control applications. In the future, this protocol can be physically deployed in indigenous low cost sensor node for Industrial control applications. Since the power requirement is low in proposed protocol, the overall cost may drastically reduce, for continuously operating delay sensitive applications.

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