A Novel Approach to Efficient Data Aggregation in Wireless Sensor Networks

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ABSTRACT

In wireless sensor network one of the major issues is maximizing lifetime of the network. In general all the sensor node sense the similar information sends it to the base station in this process the requirement of energy become very high. To decrease the energy consumption there is need to eliminate redundancy and clustering is also used. In the process of data aggregation the intermediate node which receives multiple input packets perform aggregation of data and perform single output packet in network. In this process number of redundant packet will reduce. But this redundancy sustains the reliability. In this paper there are different issues of data aggregation focused on such issues are delay, redundancy elimination, accuracy and traffic load and various methods are mention to solve this issues. In this paper Energy Efficient Cluster Based Data Aggregation algorithm is used we propose four phases Cluster formation, Cluster Head election, Data Aggregation and Maintenance. All the clusters send data to only corresponding local cluster head. The data are generated from sensor node neighboring are redundant and highly correlated thus data aggregation are created by the cluster head which reduce the redundant packet transmission to avoid the unnecessary set up of message transmission clusters are formed in a non periodic manner. Further propose the issues of data aggregation such as delay and accuracy in wireless sensor network.

General Terms
General algorithms used for improving the energy efficiency in WSN are ECBDA algorithm and LEACH algorithm, clusters .

Keywords: WSN, Data Aggregation, Cluster, LEACH algo.

I.   INTRODUCTION

Wireless Sensor Networks (WSN) is big application in areas including military, environment and medical systems. These sensor nodes are very small, inexpensive; it is self contained and battery-powered device. These sensor nodes contain the sensing module, data processing module and communication module. The basic characteristic in the wireless sensor network are having the limited energy, , short-range broadcast communication, lower power, node failure and mobility of the nodes ,dynamic network topology, and multi-hop routing and large scale of deployment. The basic architecture of the wireless sensor network which shows in fig.1 sensor node deployed in the sensor fields and for collecting the information from the environment, they are communicate with each other or directly send to the base station basically base station. The users are directly connected with the internet. A sensor node based on its sensing mechanisms observation and transmit sensed data packet to the base station (sink). In this process direct transmission occurs hence base station is may situated at very long distance from sensor nodes needs more energy to transmit data over long distances so that better techniques is to have fewer nodes sends data to the base station. These nodes called aggregator nodes and processes called data aggregation in wireless sensor network.
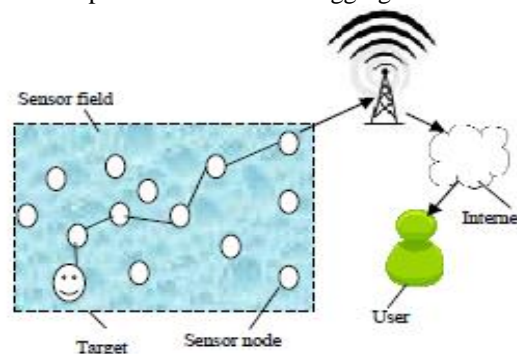

Fig.1: Architecture of WSN

Data aggregation

In the Data aggregation process the sensor data node are aggregated using aggregation approaches. In general data aggregation algorithm are used. These algorithm aggregates the data which uses the sensor data from the sensor node and then by using some aggregation algorithms such as centralized approach, LEACH(low energy adaptive clustering hierarchy), TAG(Tiny Aggregation) etc. This aggregated data is transfer to the base station by selecting the efficient path.

There are many types of aggregation techniques are present some of them are listed below.

Centralized Approach:
In this centralized approach it gives an address to centric approach where each node sends data to a central node through the shortest possible path using a multi-hop wireless protocol. The sensor nodes simply send the data packets to a main node, which is the powerful node. The head node aggregates the data which can be queried. Each intermediate node has to send the data packets addressed to leader from the child nodes. So a large number of messages have to be transmitted for a query in the best case equal to the sum of external path lengths for each node.

*In-Network Aggregation***:**
It is the global process in which of gathering and processing data, routing information through a multi-hop network at intermediate nodes with the objective of reducing resource consumption (in particular energy), thereby increasing network lifetime. In-network aggregation there are two approaches required: with size reduction and without size reduction. With size reduction refers to the process of combining & compressing the data packets received by a node from its neighbors in order to reduce the packet length to be transmitted or forwarded towards sink. In-network aggregation without size reduction refers to the process merging data packets received from different neighbors.

Tree-Based Approach:
In the tree-based approach aggregation are performed by constructing an aggregation tree, which could be a minimum spanning tree, rooted at base node and source nodes are considered as leaves. Each node has a parent node to forward its data. Flow of data starts from leaves nodes up to the sink and there in the aggregation done by parent nodes.

*Cluster-Based Approach***:**
In cluster-based approach, whole network is divided in to several clusters. Each cluster has a cluster-head which is selected from all available cluster members. Cluster heads contain the role of aggregator which aggregate data which received from cluster members locally and then transmit the result to base station.

Clustering
The group of sensor node can be combine data together and transmit only useful data. This can reduce traffic in individual group and also clustering reduce global data .This grouping of sensor nodes in a densely deployed large scale sensor node is known as clustering. In these way combination of data and compress data belonging to a single cluster called data aggregation.

II.   LITERATURE REVIEW

Sumedha Siraskar, Samarth Anavatti."Issues of Data Aggregation method in Wireless Sensor Network: A Servey", by Elsevier in 2015.[1]

In this paper focused on different issues in data aggregation process such a delay redundancy elimination accuracy and traffic load and mention various methods to solve those issues and then compared some data aggregation technique strategy, delay, redundancy, average energy consumption and traffic load.

Mohsen Rezvani, Student Member, Aleksandar Ignjatovic, Elisa Bertino, Fellow, and Sanjay Jha, "Secure Data Aggregation Technique for Wireless Sensor Networks in the Presence of Collusion Attacks", by IEEE in 2015.[2]
In this paper demonstrate that several existing iterative filtering algorithms while   significantly more robust against collusion attacks than the simple averaging methods, are nevertheless susceptive to a novel sophisticated collusion attack we introduce. To address this security issue, propose an improvement for iterative filtering techniques by providing an initial approximation for such algorithms which makes them not only collusion robust, but also more accurate and faster converging.

Yogita Hukre, Nikita V. Mahajan,"Data Aggregation Technique of Wireless Sensor Network Increasing Network Lifetime using READA".by Chennai, India, ISBN in 2015.[3]

In this paper the monitoring system and READA technique will be used. The number of sensor nodes can detect simultaneously a single target of interest. Redundant correlated data are collected. If every node sends data to the base station, energy will be wasted and thus the network energy will be consume quickly. Redundancy Elimination for Accurate Data Aggregation (READA) uses a grouping and compression mechanism to remove duplicate data in the aggregated set of data to be sent to the base station without largely losing the accuracy of the final aggregated data.

S.Nithyakalayani,B.Gopinath,"Analysis of Node Clustering Algorithm on Data Aggregation in Wireless Sensor Network", by JSIR in 2014.[4]

In this paper brief comparative study is made from different research proposal, which are vornoi based K means clustering algorithm is defined analyzed and summerized.

Ahmad AA Alkhatib, Gurvinder S Baicher, Waleed K Darwish "Wireless Sensor Network-An Advanced Survey",by IJEIT in 2013 [5]

This survey explores the design issues, network services and mechanisms and some applications in this field. It provides an understanding for WSN technology, WSN OSI architecture, and some popular protocols in each layer, the main problems and their solution of using OSI in sensor network.

Bushra Qayyum Mohammed Saeed Jason Roberts , "Data Aggregation in Wireless Sensor Networks with Minimum Delay and Minimum Use of Energy: A comparative Study", by BCS International IT in 2014.[6]

This paper discusses the recently addressed issues of data aggregation through presenting a comparative study of different research work done on minimizing delay in different structure of wireless sensor networks. Finally we introduce our proposed method to minimize both delay and power consumption using a tree based clustering scheme with partial data aggregation.

Siva Ranjani.S1,Radha Krishnan.S2, Thangaraj, "Energy-Efficient Cluster Based Data Aggregation for Wireless Sensor Networks", By IEEE in 2012.[7]

In this paper, propose an Energy efficient Cluster Based Data Aggregation scheme for sensor networks (ECBDA). This scheme has four phases: Cluster formation, Cluster head election, Data aggregation and Maintenance. Cluster members send the data only to its corresponding local cluster head. Data generated from neighbouring sensors are often redundant and highly correlated thus the cluster head performs the data aggregation to reduce the redundant packet transmission.

Nandini. S. Patil, Prof. P. R. Patil. Data Aggregation in Wireless Sensor Network", by IEEE in 2012 [8]

In this paper, a data aggregation framework on wireless sensor networks is presented. The framework works as a middleware for aggregating data measured by a number of nodes within a network. The aim of the proposed work is to compare the performance of TAG in terms of energy efficiency in comparison with and without data aggregation in wireless sensor networks and to assess the suitability of the protocol in an environment where resources are limited.

K.Ramanan1 and E.Baburaj2, "Data Gathering Algorithms for Wireless Sensor Networks: A Survey", by IJASUC in 2010.[9]

In this paper explored general network lifetime in wireless sensor networks and made an extensive study to categorize available data gathering techniques and analyze possible network lifetime on them.
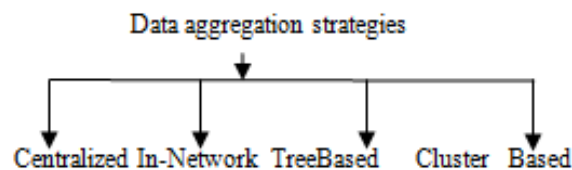
Kiran Maraiya, Kamal Kant, Nitin Gupta, "Efficient Cluster Head Selection Scheme for Data Aggregation in Wireless Sensor Network",by IJCA in 2011.[10]

In this paper gives new scheme related to clustering for data aggregation called "Efficient cluster head selection scheme for data aggregation in wireless sensor network" (ECHSSDA),also we compare our propose scheme to the LEACH clustering algorithm. Comparison is based on the energy consumption, cluster head selection and cluster formation. In which we predict that, our propose algorithm is better than LEACH in the case of consume less energy by the cluster node and cluster head sending data to the base station consume less energy as better then LEACH.

III. PROBLEM DEFINATION

Data Aggregation
In data aggregation, data are collected by sensor node and aggregated then which forward this aggregated data to the base station. There are the different strategies for data aggregation

Issues in Data Aggregation
It remove the redundancy of the data. Each data aggregation technique has some issues like redundancy, delay, accuracy and traffic load. Because this issues performance of data aggregation technique gets affected. So some method to solve these issues which belongs to clustering based data aggregation strategies.
Following are the issues in Data Aggregation

Redundancy Elimination:
In wireless Sensor Network sensor node sense the same kind of data and forward it to the sink node Sink node waste its energy in processing this redundant data so to improve lifetime of network there is need of redundancy elimination.
Delay:
Delay is nothing but time taken by receiver to receive a packet is higher than the time taken by the sender to send a packet Data aggregation function reduces redundancy but may increase delay because data from nearer sources may have to be held back at an intermediate node in order to be aggregated with data coming from sources that are further away. The cluster based method used to reduce delay in data aggregation system.
Accuracy:
In data aggregation process aggregator node performs aggregation. This aggregated data is then forwarded in to the network. So if this aggregator node get compromised or there is any compromised node repeatedly send wrong data, may leads to inaccuracy Adaptively changing cluster size method are used for accuracy in data aggregation.
Traffic Load:
In wireless sensor network the responsibility of data aggregation is given to the cluster head. If this role of cluster head is fixed to one node suffers from heavy traffic load. The node waste maximum of its energy due this traffic dynamic spanning tree approach and distributed role of cluster head this two method can be used for traffic load in data aggregation.

IV. OBJECTIVES

To design an efficient method for data aggregation in wireless sensor network. Analysis of improved method with existing method for data aggregation for wireless sensor networks.

V.   PROPOSED WORK

This proposed system applies the cluster based data aggregation for improving energy efficiency. By the use of Delay Efficient Data distributed Aggregation improving Delay process in the data aggregation. Apply the data aggregation technique for efficiency.
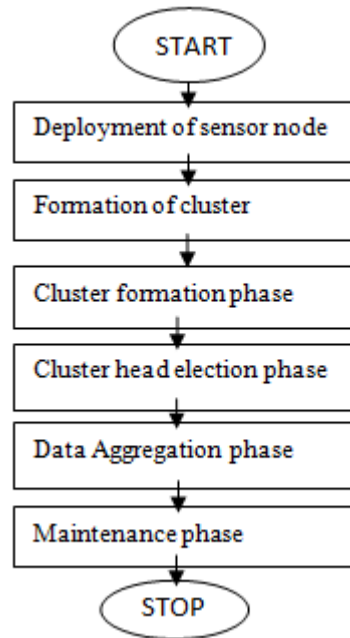

Fig.2: flow diagram for the proposed system

Cluster Formation phase:
In this phase, whole network is separated into layers then each layer is divided into a set of clusters. Base Station initiates this phase. This cluster formation is formed only once in the network. But in the maintenance phase cluster setup is altered if the cluster has too small number of alive nodes.

Cluster Head Election Phase:
Cluster head is chose on the basis of residual energy and these residual energy are communicate with other nodes in the cluster and to the Base Station. Nodes in a cluster calculate their probability to become a cluster head. For avoiding the collision CH allocates the TDMA slot for all its cluster members. On the reception of TDMA slot, all cluster members identify their CH and their time slot Member nodes send the data to its own CH only at the allocated TDMA slot All cluster members are needed to be in active state only for its TDMA slot thus for the remaining time they are in sleep state.

Data aggregation Phase:
It is defined as the process of aggregating of data from multiple sensors to which eliminate redundant transmission. In the CH works as an aggregating node. By receiving the TDMA slot, all cluster members sends the main information to its CH. Each CH waits for one TDMA frame which collect the information from its member nodes. After each TDMA frame, CH aggregates the received information and forwards the aggregated data to the base station. In proposed method, use the data aggregation algorithm and max function in the CH.

Maintenance Phase:
In the maintenance process if the cluster head is static, then its node always dissipate more energy. Subsequently the head node dies quickly. So this maintenance phase to change the cluster head over a time period. If the total number of nodes alive in a cluster is less than 50% of its initial number of nodes then that cluster members joins with other closer clusters in the same layer. This process of modifying the cluster setup is called as Re-clustering.

VI.   CONCLUSION

In the Data Aggregation there are many issues are occurred like redundancy, accuracy, delay and traffic load. There are various method for solving this problem. The method are found to increase the energy efficiency remove the issues in data aggregation in wireless sensor network by using LEACH algorithm and new method

REFERENCES

1.   *B Sumedha Siraskar, Samarth Anavatti."Issues of Data Aggregation method in Wireless Sensor Network: A Servey", by Elsevier in 2015.*
2.   *Mohsen Rezvani, Student Member, Aleksandar Ignjatovic, Elisa Bertino, Fellow, and Sanjay Jha Secure Data Aggregation Technique for Wireless Sensor Networks in the Presence of Collusion Attacks", by IEEE in 2015.*
3.   *Yogita Hukre, Nikita V. Mahajan"Data Aggregation Technique of Wireless Sensor Network Increasing Network Lifetime using READA".by Chennai, India,ISBN in 2015*
4.   *S.Nithyakalayani,B.Gopinath,"Analysis of Node Clustering Algorithm on Data Aggregation in Wireless Sensor Network",by JSIR in 2014.*
5.   *Ahmad AA Alkhatib, Gurvinder S Baicher, Waleed K Darwish "Wireless Sensor Network An Advanced Survey",by IJEIT in 2013*
6.   *Bushra Qayyum Mohammed Saeed Jason Roberts ," Data Aggregation in Wireless Sensor Networks with Minimum Delay and Minimum Use of Energy: A comparative Study", by BCS International IT in 2014.*
7.   *Siva Ranjani.S1,Radha Krishnan.S2, Thangaraj" Energy-Efficient Cluster Based Data Aggregation for Wireless Sensor Networks", By IEEE in 2012.*
8.   *Nandini. S. Patil, Prof. P. R. Patil. Data Aggregation in Wireless Sensor Network", by IEEE in 2012.*
9.   *K.Ramanan1 and E.Baburaj2 Data Gathering Algorithms for Wireless Sensor Networks: A Survey", by IJASUC in 2010.*
10.   *Kiran Maraiya,Kamal Kant,Nitin Gupta "Efficient Cluster Head Selection Scheme for Data Aggregation in Wireless Sensor Network",by IJCA in 2011.*
11.   *Fengyuan Ren, Jiao Zhang,Yongwei Wu, Tao He, Canfeng Chen and Chuang Lin,Attribute-Aware Data Aggregation Using Potential-Based Dynamic Routing in Wireless Sensor Networks",IEEE ,2012.*
12.   *Mohsen Rezvani, Student Member, Aleksandar Ignjatovic, Elisa Bertino, Fellow, andSanjay Jha, Senior Member Secure Data Aggregation Technique for Wireless Sensor Networks in the Presence of Collusion Attacks Mohsen" , IEEE, 2015.*
13.   *ShaohuaWan," Energy-Efficient Adaptive Routing and Context-Aware Lifetime Maximization in Wireless Sensor Networks"Hindawi,2015*
14.   *Leandro A. Villas a,b, Azzedine Boukerche a, Horacio A.B.F. de Oliveira c," A spatial correlation aware algorithm to perform efficient data collection in wireless sensor networks", Elsevier, 2011*