Implementation of Energy Efficient Clustering with BNS using Data Cube Aggregation Technique

Sumit Chaudhary, Neha Singh, Nishant Kumar Rathi, Raju Dixit

Abstract— A multidisciplinary research area such as wireless sensor networks (WSN) have been invoked the monitoring of remote physical environment and are used for a wide range of applications. Sensor networks are the key to gathering the information needed by smart envi ronments, whether in buildings, utilities, industrial, home, shipboard, transportation systems automation, or elsewhere ranging from defense personnel to many scientific research, statistical application, disaster area and War Zone. The problem encountered in the recent was of the more battery power consumption as activity increases, need more efficient data aggregation techniques with right decision making capabilities. Therefore, this paper proposed the efficient and effective architecture and mechanism of energy efficient techniques for data aggregation in WSN using principles like global weight calculation of nodes and data aggregation techniques using data cube aggregation

Index Terms— Wireless Sensor Network, Clustering, data aggregation, Energy efficient, BNS

1 INTRODUCTION

A multidisciplinary research area such as wireless sensor networks [2, 4, 6, 7, 18] where close collaboration between users, application domain experts, hardware designers, and software developers is needed to implement efficient systems. Wireless sensor networks consist of small nodes with sensing, computation, and wireless communications capabilities. Many routing, power management [17, 19] and data dissemination protocols have been specifically designed for WSNs where energy awareness is an essential design issue. Routing protocol [5, 20] in WSNs might differ depending on the application and network architecture

Sensor node are densely deployed in wireless sensor network that means physical environment would produce very similar data in close by sensor node and transmitting such type of data is more or less redundant. So all these facts encourage using some kind of grouping of sensor nodes such that group of sensor node can be combined or compress data together and transmit only compact data. This can reduce localized traffic in individual group and also reduce global data. This grouping process of sensor nodes in a densely deployed large scale sensor node is known as clustering. The way of combing data and compress data belonging to a single cluster called data aggregation.

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Wireless Sensor Network [1, 2, 4, 6] generates a large amount of data that has to be aggregated at various levels. A multidimensional aggregation approach [7, 9, 13, 14, 15] is considered for exhibiting the node parameters for each network. Bandwidth, memory, signal strength, time, battery power etc. have been utilized to examine the performance of a sensor network, its efficiency can be enhanced by reducing the cost of cluster development. Sensor nodes are becoming popular in mobile communication technology due to their fast communication speed and better result generation in information systems.

In typical wireless sensor networks, sensor nodes are usually resource-constrained and battery-limited. In order to save resources and energy, data must be aggregated to avoid overwhelming amounts of traffic in the network. There has been extensive work on data aggregation schemes in sensor networks, The aim of data aggregation is that eliminates redundant data transmission and enhances the lifetime of energy in wireless sensor network. Data aggregation is the process of one or several sensors then collects the detection result from other sensor. The collected data must be processed by sensor to reduce transmission. Data transmission between sensor nodes, aggregators and the queries consumes lot of energy in wireless sensor network. The problem encountered in the recent past was of the battery power consumption [5, 6], more efficient data aggregation and collection techniques with right decision making capabilities, Therefore, this paper proposed the efficient and effective architecture and mechanism for mentioned problem using principles like global weight calculation of nodes, data collection for cluster head and data aggregation techniques using data cube aggregation.

2 BACKGROUND

A multifaceted approach in the field of WSN for research has been undertaken in recent past. Several Parameters were used for decision making, especially in disaster and war zone with a limited field of works. Therefore the efficiency and power consumption [5, 6] was of very much concern and conflict in usage. Sensor networks are quintessentially event-based systems. A sensor network consists of one or more "sinks" which subscribe to specific data streams by expressing interests or queries. The sensors in the network act as "sources" which detect environmental events and push relevant data to the appropriate subscriber sinks. For example, there may be a sink that is interested in a particular spatio-temporal phenomenon ("does the temperature ever exceed 70 degrees in area A between 10am and 11am ?"). During the given time interval all sensors in the corresponding spatial portion of the network act as eventbased publishers. They publish information toward subscribing sink if and when they detect the indicated phenomenon. Because of the requirement of unattended operation in remote or even potentially hostile locations, sensor networks are extremely energy-limited. However since various sensor nodes often detect common phenomena, there is likely to be some redundancy in the data the various sources communicate to a particular sink. In-network filtering and processing techniques can help conserve the scarce energy resources. Data aggregation has been put forward as an essential paradigm for wireless routing in sensor networks. The idea is to combine the data coming from different sources enroute eliminating redundancy, minimizing the number of transmissions and thus saving energy. This paradigm shifts the focus from the traditional address centric approaches for networking (finding short routes between pairs of addressable end-nodes) to a more data centric approach (finding routes from multiple sources to a single destination that allows in-network consolidation of redundant data). There is no efficient techniques were present in previous ages that could enable a better power and battery efficient framework for data transfer. Continuous research and development in the field has provided new improved solutions so that the clustering methods can be used for efficient outputs. The flexibility, fault tolerance, high sensing fidelity, low cost, and rapid deployment characteristics of sensor networks create many new and exciting application areas for remote sensing [3, 5, 9, 13, 15 and 23]. This wide range of application areas will make sensor networks an integral part. However, realization of sensor networks needs to satisfy the constraints introduced by factors such as fault tolerance, scalability, cost, hardware, topology change, environment, and power consumption.

A WSN consists of a large number of sensor nodes. Each sensor node senses environmental conditions such as temperature, pressure and light and sends the sensed data to a base station (BS), which is a long way off in general. Since the sensor nodes are powered by limited power batteries [5, 6] in order to prolong the life time of the network, low energy consumption is important for sensor nodes. In general, radio communication consumes the most amount of energy, which is proportional to the data size and proportional to the square or the fourth power of the distance. In order to reduce the energy consumption, a clustering and data aggregation [7, 9, 13, 14, 15 and 23] approach has been extensively used. In this approach, sensor nodes are divided into clusters, and for each cluster, one representative node, which called cluster head (CH), aggregates all the data within the cluster and sends the data to BS. Since only CH nodes need long distance transmission, the other nodes save the energy consumption. Efficient data collection [2] in WSN plays a key role in power conservation. It has spurred a number of researches focusing on effective algorithms that reduce power consumption with effective in-network aggregation techniques. Up to now, most approaches are based on the assumption that data collection [11] involves all nodes of a network. There are large numbers of queries that in fact select only a subset of the nodes in a WSN. Thus, the selective queries like queries that request data from a subset of a WSN. It is also argue that selective queries are an important class of queries that can benefit from algorithms that are tailored for partial node participation of a WSN.

3 PROPOSED ARCHITECTURE OF ENERGY EFFICIENT TECHNIQUES FOR DATA AGGREGATION

3.1 Working Principle

The working of WSN proposed architecture model illustrated in Figure- 1, works by selecting group of nodes and divided into clusters. These clusters will satisfy the intended parameter requirements and conditions. The parameters like distance, RSSI, TTL, battery consumption were used to determine the number of nodes that would be considered in a cluster. Now a cluster head (CH) is selected among nodes lies inside each and every cluster. CH will be responsible for administration of all other nodes inside respective cluster and collecting the data from nodes inside the cluster and transferring the data to the neighboring cluster head for further information exchange and updates. The newly arrived nodes will be assigned as cluster head if the global cost of arrived node is minimum, otherwise other cluster nodes will be given opportunity to participate and global cost is again recalculated. After that the data aggregation approach is presumed as the collection of data and various queries from the user end are checked and transformed into low level schemes by a query processor. All data collected and aggregated is stored at a storage location in database server. Finally at last the data is aggregated by data cube approach and all the aggregated data will be transfer to the base station for further use.

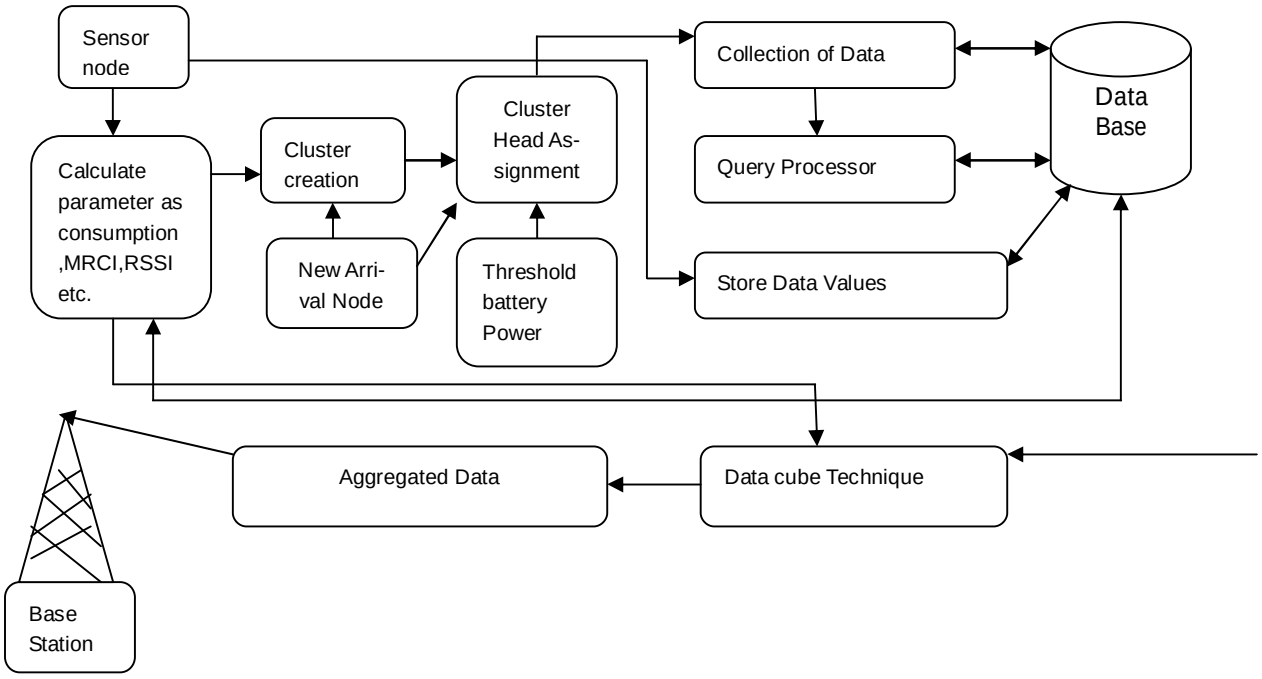

Fig. 2. Architecture of Data Collection and Aggregation for WSN

Sensor node: Sensor node is the primary working component that performs various activities like cluster creation, data collection, transfer data among switching centers and so on.

Sensors Parameters: The parameters like bandwidth, memory, time-to-live, radio signal strength Indicator (RSSI), MRIC are identification factors for WSN architecture.

Newly Arriving Node: Current numbers of nodes present in the cluster and newly arriving nodes are managed by functional parameters used in cluster creation parameters.

Cluster Creation: Collection of nodes that satisfy the parameter requirements ultimately form a cluster.

Cluster Head Assignment: An individual cluster head is selected by evaluating the minimum cost of that node who will serve as the head.

Threshold battery power: Threshold battery power is checked or evaluated against the present status of battery of the cluster head.

Collection of Data: Data is collected from various nodes participating in the communication and stored in a remote location for further access.

Query Processor: User defined queries are accepted and generated at clients end and data is retrieved from the database for a specific query.

Aggregation: Aggregation technique like data cube collection approach has been used for storage of node parameter values and cluster locations (Base Station). Data cube approach supports various phases in a graphical format that is easy to understand and access

3.2 Proposed Mechanism of Energy Efficient Techniques for Data Aggregation and Collection in WSN

The proposed mechanism is discussed into three phases.

Phase 1 - Cluster creation in WSN

Step 1:- Assign node id for each node of WSN:

```
No of node=N
For (i=0; i<N; i++)
{
        ss_id[i] =RandomNoGenerator ( );   // ss_id is Sub System ID
 }
```

Step 2:- cluster creation:

```
ClusterCreation ( )
{
For (ss_id=0; ss_id<N; ss_id++)
{

If (Dbs> Dmax && RSSInew < RSSITH && BRL<BTH)
        /*Dbs= Distance between base station and node i

Dmax=Maximum Distance
```

RSSI$_{new}$=Reverse Signal Strength Indication of new node
RSSI$_{TH}$=Threshold Reverse Signal Strength Indication

Node will not be included in the cluster
}
else
{
Join the cluster
}

Phase 2- Cluster Head Assignment in WSN:

Step 1: ClusterheadAssignment ( )

For (cluster$_1$ to cluster$_n$)
{
Min = ∞
For (ss_id=0; ss_id < N; ss_id++)
{
/*Evaluate C (i)
/C (i) = E_{con} (i)B_{IL}/B_{RL} (i) +D_{BS} (i)/D_{max}+ M_{con} (i) *M_{IL}/M_{RL}
M_{IL}=Initial Memory Level
M_{RL}=Residual Memory
M_{con}=Memory Consumption*/
if C (i) < min
min = C (i);
}
}

Step 2:- Newly arriving node in WSN:

NewlyArrivingNodeInWSN ()
{
If (D_{bs} > D_{max} && RSSI$_{new}$ < RSSI$_{TH}$ && B_{RL}<B_{TH})
{

if (newlyarrivelnode (c(i)) < min)
{
Assign new node as a CH;
/* Cluster Head */
}
else
{
New Node Joins cluster;
}
}
Else
{
Node is not allowed to join the Cluster;
}

Phase 3 – Cluster Head Data Aggregation:

ClusterHeadDataAggregation ( )
B_{RL}=Residual Battery Level
B_{TH}=Threshold Battery Level*/
{

- The node has to be associated with various parameters.
- The parameters useful for node information are collected and stored at each cluster head.

{

- All the nodes are aggregated at cluster level.
- The cost is evaluated on the basis of collected parameters.
- Minimum cost is evaluated.
- All the cost parameters are send to the cluster head for further aggregation.
- Next the transfer is to the base station.

}

4 Data Cube Aggregation

It is a multidimensional approach for data aggregation. The values are stored in separate cell of a data cube, each phase of cube is divided into separate rows & columns and each value & node such as consumption, memory, RSSI, TTL etc are represented at the beginning of rows.

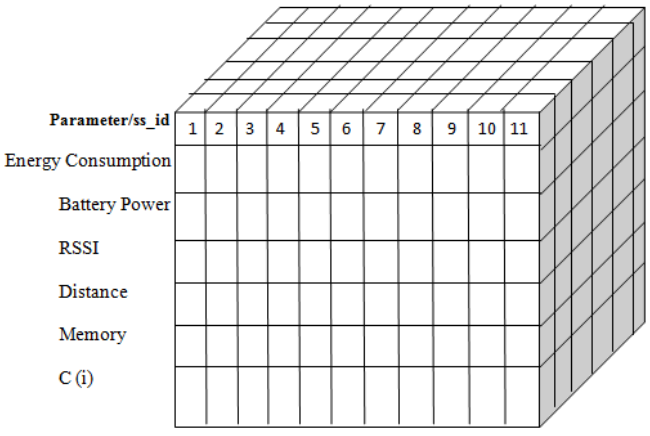

Fig. 2. Data cube technique related to data aggregation

5 Conclusion

The paper widely acclaims the improved technology for energy efficient techniques for data aggregation and collection in WSN. The result provides the accurate usage of battery and low power consumption so that the user can send multiple messages in limited resources. The parameters are used to

manage the cluster head generation , and the node selection methods so that the messages csn be easily transferred under such circumstances with right decision using principles like global weight calculation of nodes, data collection for cluster head and data aggregation techniques using data cube aggregation.

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