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A Parametric Analysis Approach for Improved Clustered Communication in WSN

Geetika Rana
Student, ECE, Apax Engg. College
Panipat, Haryana, India

Priyanka Kakkar
Associate Professor., ECE, Apex Engg. College,
Panipat, Haryana, India

Abstract— Clustering is the base architecture of any sensor network. To improve the communication and the life of such network, there is the requirement to improve the clustering approach. In this present work, an effective clustering approach is presented under different parameters. The parameters considered in this work for the cluster head selection are in terms of some constraints that are applied while selecting the cluster head. Here the cluster head selection is defined under some restrictions. We have assigned a limit on the maximum number of possible clusters in a network. We have defined the lower limit to decide the minimum number of cluster members in a network More over to these constraints, some restrictions are also applied in terms of energy and distance parameters. The presented work is implemented in Maltab Environment and the obtained results shows that the presented work has improved the communication significantly.

Keywords: Clustered, Parametric, Constraint Specification, Energy Effective

I. INTRODUCTION

Wireless Sensor Networks (WSNs) are usually self-organized wireless ad hoc networks comprising of a large number of resource constrained sensor nodes. Wireless sensor networks are consisted of hundreds or thousands of small sensors that have limited resources such as computing power, memory, bandwidth and power supply (Akyildiz, Su, Sankarasubramaniam & Cayirci, 2002, [11]. The concept of sensor networks is fairly new and the first article on the wireless sensor network (WSN) concept was published in 1998 (Asada et al., 1998). 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 ranging from defence personnel to many scientific research, statistical application, disaster area and War Zone.

These networks are constraint with energy, memory and computing power enhance efficient techniques are needed for data aggregation, data collection, query processing, decision making and routing in sensor networks [12]. The problem encountered in the recent past was of the more battery power consumption as activity increases; need more efficient data aggregation and collection techniques with right decision making capabilities. A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions such as light, sound, humidity, temperature, motion, pressure, vibration and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity [10]. As a result of this variety, WSNs support a wide range of applications. Arora et al. (2004) proposed a WSN for security and defence applications while Shen, Wang and Sun (2004) used WSNs for industrial automation. Some researchers also studied WSNs for habitat monitoring (Mainwaring, Culler, Polastre, Szewczyk &Anderson, 2002). Another application is a traffic control system demonstrated by Wenjie, Lifeng, Zhanglong and Shiliang (2005). Malan, Fulford-Jones, Welsh and Moulton (2004) offer a healthcare application using WSNs. One final example is a fire tracking application established on a WSN is demonstrated by Fok, Roman and Lu (2005). WSNs pose various challenges such as limited resources of motes, heterogeneity of nodes, network deployment, communication failures, security, routing, and programming. According to Boulis, Han and Srivastava (2003), programming wireless sensor networks is one of the most important challenges of WSNs.

A) Aggregation

Data aggregation is very crucial techniques in wireless sensor network. Data gathering is defined as the systematic collection of sensed data from multiple sensors to be eventually transmitted to the base station for processing. Since sensor nodes are energy constrained, it is inefficient for all the sensors to transmit the data directly to the base station. Data generated from neighboring sensors is often redundant and highly correlated. In addition, the amount of data generated in large sensor networks is usually enormous for the base station to process. Hence, we need methods for combining data into high quality information at the sensors or intermediate nodes which can reduce the number of packets transmitted to the base station resulting in conservation of energy and bandwidth. This can be accomplished by data aggregation. *Data aggregation* is defined as the process of aggregating the data from multiple sensors to eliminate redundant transmission and provide fused information to the base station. Data aggregation usually involves the fusion of data from multiple sensors at intermediate nodes and transmission of the aggregated data to the base station (sink). In the rest of the paper, we use the term data aggregation to denote the process of data gathering with aggregation. We also use the term sink to represent the base station. Data aggregation attempts to collect the most critical data from the sensors and make it available to the sink in an energy efficient manner with minimum data latency.

B) Performance Measures
There are very important performance measures of any clustering algorithm. These performances are highly dependent on the desired application.
Energy Efficiency: By the data-aggregation scheme, we can increase the functionality of the wireless sensor network. In which every sensor nodes should have spent the same amount of energy in every data gathering round. A data-aggregation scheme is energy efficient if it maximizes the functionality of the network. Network lifetime, data accuracy, and latency are some of the significant performance measures of data-aggregation algorithms. The definitions of these measures are highly dependent on the desired application.
Network lifetime:The network lifetime is defining the number of data fusion rounds. Till the specified percentage of the total nodes dies and the percentage depend on the application .If we talk about some application, simultenously working of the all the sensor nodes is crucial hence the lifetime of the network is number of round until the first nodes which improves the energy efficiency of nodes and enhance the lifetime of whole network.
Latency: Latency is evaluate data of time delay experiences by system, means data send by sensor nodes and received by base station(sink).basically delay involved in data transmission, routing and data aggregation.
Communication overhead: It evaluates the communication complexity of the network fusion algorithm.
Data accuracy: It is a evaluate of ratio of total number of reading received at the base station (sink) to the total number of generated. There are different types data- aggregation protocols like network architecture based data aggregation protocols, network-flow-based data-aggregation protocols and quality of service (QOS)-aware data aggregation protocols designed to guarantee QOS metrics.

II. EXISTING WORK
Samer Hanoun, et al. (2008) modeled the mobile collector and the sensor network as a system-of-systems, and types of interactions. They presented the framework that assists deploying incongruous mobiles without prior knowledge about the sensor network. They proposed a model for governing the interactions between the sensor network and class of mobile elements acting as data collectors. They showed a methodology of structuring the sensor network for conveying collection request to the mobiles without knowing their positions or number. Two motion heuristics are presented to guide the collection tour of the mobile element. They argue that the proposed framework is both practical and simple for providing loose coupling between the network and the mobile collectors. **W. H. Liao, et al. (2008)** proposed an ant colony algorithm for data aggregation in WSNs. Each ant explores all possible routes from a source node to the Sink. The result of accumulated pheromone used in the constructed of data aggregation tree. But the construction of the appropriate tree depends largely on the deployment of nodes, which is generally random, and therefore consumes a significant amount of energy. However, the Euclidean distance calculated from a source node to the Sink may not be applicable in WSNs, because the communication range of a node is limited. **Pugliese, et al. (2009)** worked on the needed security level in WSNs, by using multiple agents. This approach taken to designing a Cross-Layer framework in the sake of providing security to WSN is a good solution for introducing distributed autonomic security methods that allow using mobile agents and stationary agents to provide security in the WSN. A special attention has to be given to MA authenticity and protection from being compromised by malicious code.
A.S. Poornima, et al. (2010) proposed a simple authentication scheme for heterogeneous sensor network which uses mobile agents for efficient data collection. There proposed scheme is used to recognize and find malicious nodes acting as mobile agents. Also attaining confidentiality of the data collected using simple key derivation technique which allows a cluster head to encrypt the data every time using a different key which can be easily derived by the base station. Mobile agents is used to collect the data is becoming popular in wireless sensor networks. Regarding security there were challenges when mobile agents are used for data collection. They have proposed a simple authentication scheme which is derived using the tree based key management scheme. The proposed scheme identifies malicious MA and replay messages. Through using refreshed secret key Pi transferred data is encrypted. The secret key is known only to CH and base station. Hence the scheme is resilient to compromise of MA. **Tao Shu, et al. (2010)** developed mechanism that generates randomized multipath routes. Under their designs, the paths taken by the shares of different packets changes over time. So even if the routing algorithm becomes known to the opponent, the opponent still cannot point out the routes cross over by each packet. Besides irregularities, the generated paths are also highly distributive and energy efficient, making them quite capable of mislead black holes. They tentatively check out the security and energy performance of the proposed schemes. They also formulate an optimization problem to decrease the end-to-end energy consumption under given security compulsions. Wide simulations are conducted to verify the validity of our mechanisms. They propose arbitrary multipath routing algorithm that can overcome the above problems. In their approach, multiple paths are computed in arbitrary way each time an information packet needs to be sent, such that the set of routes taken by various shares of different packets keep changing over time. As a result, a large number of routes can be conceivably generated for each source and destination. To interrupt different packets, the opponent has to accord or jam all possible paths from the source to the destination, which is practically not possible.

III. PROPOSED WORK

One of the major concept of sensor network is clustering. According to this concept complete network is divided in smaller clusters and each cluster is controlled by a cluster head. There are number of existing approaches to identify the cluster head. The cluster head decision is generally taken based on the energy and the distance requirement. The present work is about to improve the clustering concept under following parameters. The cluster head selection will be performed based on three main parameters called Distance, Residual Energy and Response Time.

Along with this work, the capacity of the cluster head will defind with maximum threshold. It means, each cluster can have maximum n nodes. The minimum capacity of a cluster head will be defined in terms of energy specification, if energy get decreased to that level. The reformation of clustering is required. If defined number of clusters cannot cover all the nodes over the network then multihop communication will be performed. The communication will be done by selection on nearest node that is covered by any cluster head. All the clusters heads itself form a multihop communication to interact with base station. The output will be driven in the form of network life.

The primary cluster head is the main cluster head of a cluster that is responsible to control the communication over a cluster. The cluster head will accept the information from the cluster nodes and will send it to the base station with direct or with cooperative communication. In this work, we have defined a new cluster head specification approach under the following specification

(i) We have defined the minimum and maximum number of clusters over the sensor network so that the uniform distribution will be performed.

(ii) We have defined the minimum number of nodes that will be connected to the main cluster head at any instance of time. This is basically to perform the localization in sensor network. So that the chances of node loss will be reduced.

(iii) All the cluster heads are disjoints it means no node will participate to more than one cluster.

A) Algorithm

```
Algorithm(Nodes,N)
{
(i) Design a network with N number of nodes and with specific constraints like energy, position etc.
(ii) Define the base station called bs for the network.
(iii) Define the probalistic vector for the selection of cluster head. Initially the probability vector will be defined equally
(iv) Generate a neighbor list to track the neighboring nodes so that the node monitoring will be performed and the chances of node loss will be reduced.
(v) Set ClusterHead=1;
(vi) Set MaxEnergy=0
(vii) Set MaxConnectivity=0
(viii) Set MinResponseTime=Inf
(ix) For i=1 to n
(x) {
(xi) If (Type(i)='Normal')
(xii) {
(xiii) For j=1 to N
(xiv) {
(xv) If (SensingRange(I,j)<=Threshold)
(xvi) {
(xvii) If(Type(Node(j))='ClusterHead')
(xviii) {
(xix) Print "Clusterhead already Exist & Break
(xx) }
(xxi) Else
(xxii) {
(xxiii) Count=Count+1
(xxiv) }
(xxv) }
(xxvi) If (Count >Threshold)
(xxvii) {
(xxviii) ProbabilityVector(Node(i)) = Energy(Node(i))*ProbabilityVector(Node(i))+ (1-ProbabilityVector(Node(i)))* EnergyConsumed(Node(i))
(xxix) If (ProbabilityVector(Node(i))>.5)
(xxx) {
(xxxi) If(Energy(Node(i))> MaxEnergy And ResponseTime(Node(i))< MinResponseTime And ConnectivityVector(Node(i))>MaxConnectivity
(xxxii) {
(xxxiii) Set MaxEnergy=Energy(Node(i))
```


(xxxiv) Set MinResponseTime= ResponseTime(Node(i)
(xxxv) Set MaxConnectivity= ConnectivityVector(Node(i))
(xxxvi) Set ClusterHead=i
(xxxvii) }
(xxxviii) }
(xxxix) }
}

IV. RESULTS

The presented work is implemented in Matlab environment under different scenarios. The scenario used in the system is defined as under

No. of Nodes (n) = 100
Optimal Election Probability of a node to become cluster head (P) = 0.2;
Initial Energy (Eo) = 0.5;
Energy for Transmission (ETX)= 500*0.000000001;
For Energy Reception (ERX) = 500*0.000000001;
Maximum no. of Rounds (rmax) = 1000;

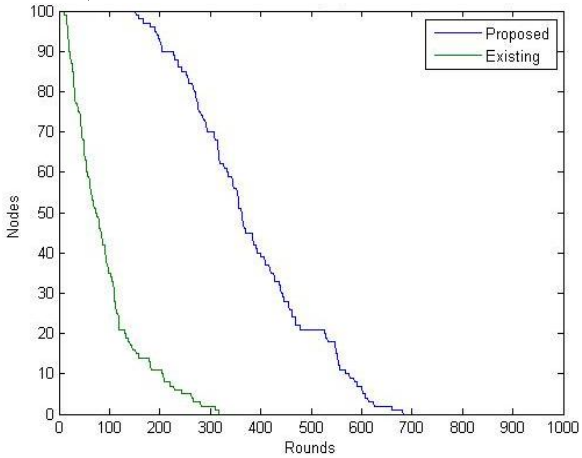

Figure 1 :Alive Nodes

Figure 1, the number of alive nodes at a regular round interval. In this, we can see that all the sensor nodes were alive till round 680 in our proposed approach where as in existing approach it was up to 320 only. Thus, the life time of the proposed approach is comparatively greater than the existing approach. As we can see the presented approach has reduced the energy consumption ratio over the network, so that the life of network is improved as the moves are alive for the more time. The life of the network is improve up to 350 rounds.

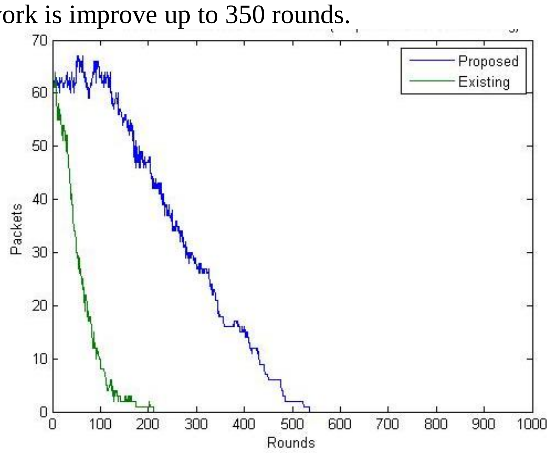

Figure 2 : Data Communication over the network

Here figure 2 shows the higher numbers of packets are transmitted in proposed approach as the network life is increased. The presented approach provided the better clustering approach so that the equalize distribution of cluster over the network is performed. The presented work improved the inter cluster communication over the network.

IV. CONCLUSION

The presented work is about to improve the existing clustering approach with the inclusion of some constraints so that the effective communication will be achieved. The results shows that the presented work has improved the network life as well as network communication.

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