Effect Of Grouping Cluster Based on Overlapping FOV In Wireless Multimedia Sensor Network

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Abstract— **Wireless multimedia sensor network (WMSN) uses multimedia nodes to sense the area that are un-correlated to the areas sensed by the neighboring sensors. Because of huge amount of data produced in wireless multimedia sensor network, existing clustering schemes of wireless sensor network is not appropriate for WMSN. Overlapping FoVs of multimedia nodes is one of those clustering scheme which is found relevant for wireless multimedia sensor network. This paper analyzes the enhancement of present clustering scheme of energy conservation by forming groups of cluster which conserves more energy and prolongs network lifetime. Coordination among group, cluster and cluster member conserve more energy and enhances performance of network.**

Keywords- ***Clustering, Coordination, Group , Field of View, Energy Conservation, Wireless Multimedia Sensor Network***

I. INTRODUCTION

Wireless Sensor Networks (WSN), are considered as autonomous and self-organizing systems consisting of a large number of small, inexpensive, battery-powered communication devices deployed throughout a physical space. These networks are intended for gathering information related to the surrounding environment like temperature, humidity, light, etc and for transmission of the gathered data to a base station (i.e., sink), and then further processing.

In recent era there has been increased interest in video surveillance and environment sensing applications. Multimedia is media and content that uses a combination of different content forms. Multimedia sensors are generally used in wireless multimedia sensor network (WMSN) [3],for application monitoring and should be able to process in real-time, retrieve or fuse multimedia data. By using CMOS cameras embedded in wireless sensor nodes, visual information may be captured from the environment.

Energy conservation and maximization of system lifetime is commonly recognized as a key challenge in the design and implementation of WSNs. One of the subjects that have been propounded for enhancement in efficiency of applications associated with WSNs, is node clustering. Clustering in WSN pursues several objectives: (i) network scalability, (ii) energy conservation, (iii) network topology stabilization, (iv) routing overhead minimization, (v) optimized management strategies to prolong battery life and network lifetime and (vi) efficient data aggregation.

Sensing region of multimedia nodes is very different from ordinary nodes in WSNs. Each multimedia node has a Field of View (FoV) and it only capture images from the objects within that region. Moreover, video cameras capture images of objects of a region that are not essentially in the camera's locality. The object covered by the camera can be distant from the camera and the captured images will depend on the relative positions and orientation of the cameras towards the observed object. So, due to non-coincidence between radio neighborhood and sensed region by multimedia nodes, node clustering and coverage techniques in WSN do not satisfy WMSN requirements. Further development of low cost, low power, low resolution camera sensors over a dense network consisting of multimedia sensors has become appropriate. This kind of deployment provides more performance by high power, high resolution cameras.

In a densely deployed sensor nodes overlapping FoVs causes wasting power of system because of redundant sensing of area. In this paper, we present an approach for multimedia node grouping of cluster formed that satisfies FoV constraints to overcome this problem. In this approach, formation of group comprising cluster head and their member aims to reduction of energy consumed in data transmission. It also focus over the method that one node of each cluster works at a time and rest go to sleep mode. Moreover one by one utilizing every node energy of the cluster prolongs network

II. RELATED WORK

Various works and surveys presents clustering protocols and algorithm in the field of WMSN and provides main factors for designing relevant algorithm. Enhancing basic concept cluster formation, cluster-head selection, group-head selection then group member selection and then data transfer are the key factor of this algorithm.

Multimedia sensors are powerful multidimensional sensors that can capture that captures directional view. We assume wireless sensor nodes with fixed lenses providing a θ angle FoV, deployed densely in random manner. The monitoring area consists of N wireless camera sensors, represented by the set, S={S1,S2,...,SN}.

Basic definition are used in the paper[1]

Field of View (FoV): refers to the directional view of a multimedia sensor and it is assumed to be an isosceles triangle (two-dimensional approximation) with vertex angle θ, length of congruent sides Rs (sensing range) of the sensor and orientation α. The sensor is located at point A (xA,yA).

Cluster (Cj, j=1,…,M): consists of a subset of multimedia nodes with high overlapping FoV areas. The size of overlapping area between FoVs of two nodes determines whether they can be in the same cluster.

Clustering threshold (γ): defines the minimum percentage of node's FoV area that is required to be overlapped for membership in a cluster.

Group (Gk): consists of a subset of cluster including cluster head as a member joined to group with all its nodes. The size of group is predefined percentage of cluster formed.

We have considered a cluster architecture based on WMSN[1].In the earlier paper[1], the author had proposed a WMSN clustering based on Field of View(FoV).The area overlapped between the FoV of each camera was found out. Then according to that the cameras whose overlapped area crossed a certain threshold value were placed in one cluster. So in each cycle if a camera from all the clusters were waken then the energy conservation for the entire network was enhanced.

A. Overlapping areas between FoV of multimedia nodes

For the Euclidean distance of more than 2Rs, FoV of two nodes doesn't overlap. Otherwise, it is possible to have overlapped regions between their FoV depending on the orientation angles α.For calculating the FoV overlapping area of two nodes, firstly intersection of the triangles that are the representatives of their FoVs. Second, if they intersect each other, we find the intersection polygon and at last, compute the area of the polygon. We define the equations of sides of each triangle using coordinates of vertices of each triangle.We survey the intersection of each side of each triangle to all sides of the other triangle (i.e., the perimeter of the triangle). Finally, a decomposition method is used for calculating the area of the overlapped polygon in a 2D-plane in third step.

After formation of cluster further grouping of cluster has been done .In due course firstly group-heads selection is done, first group head is selected randomly from the set of all the cluster-head. Then for next group-head selection distance of all the cluster-head from randomly selected group-head is compared, distance should be kept more than twice the sensing range, this way all the group head are selected. After selecting group-head group members are decided, all the cluster head is considered for the group member and these cluster head joins the group with their cluster member automatically.

Then for the conservation of energy one node of each cluster is kept awake for processing rest all nodes where kept in sleep mode. This way energy preserved and network lifetime prolongs. As the sensing camera captures multimedia data so it awakes for a very less time and in that time slot it awakes, captures and transmits data to base station or respective head either group or cluster.

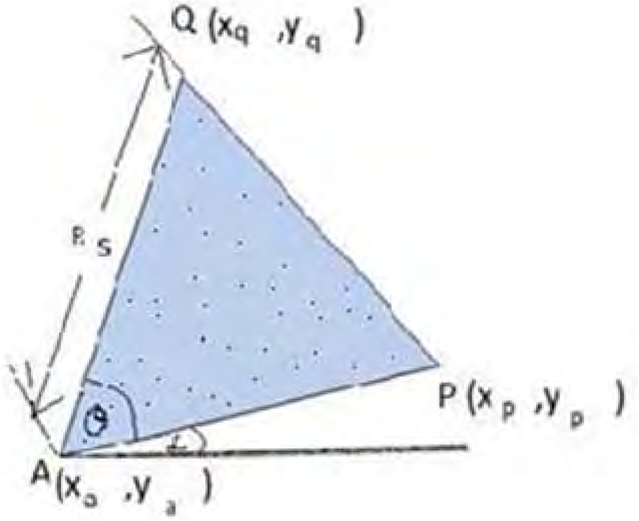

Fig. 1 FoV of multimedia sensor

B. Algorithm

Above mentioned concept is described below using this algorithm

a. Cluster formation and cluster membership

1. For each i un-clustered multimedia node
2. Create an empty clustered k
3. i is the first member of cluster k
4. For each j un-clustered multimedia node
5. Find intersection polygon of i and j
6. Compute A(i , j) , overlapped area between i , j
7. If A(i , j) > Threshold area
8. j is clustered multimedia node
9. j is the member of k
10. End if
11. End for
12. End for

b. Group head selection and formation of group

1. For each un-grouped cluster
2. NG=Number of group formed is predefined percentage of k(cluster)
3. For each k un-grouped cluster
4. Create an Group head(GH1) first randomly
5. For each k-1 un-grouped cluster
6. Compare distance between (GH1) and (k-1)
7. If distance>=2*Rs & min(distance)
8. That cluster head of cluster becomes the GH
9. End if
10. End for
11. End for

12. For every group head
13. For every cluster
14. Calculating distance between all the group heads and cluster heads
15. Minimum of these distances containing cluster head joins Group head
16. Cluster head joining group head automatically join with all of its member
17. End for
18. End for
19. End for

C. Data Transferring and group-head selection for the next round

Group once formed remains static throughout the network lifetime. But in every rounds group head are selected by comparing energy. Simultaneously calculation of dead nodes after every round has to be taken into account. Energy of node is consumed is broadcasting, reception, transmission and capturing, moreover first order radio model is used for calculating energy in every round for every group, for every cluster and their corresponding nodes.

After establishing network architecture eligible nodes of the clusters of the group forward their data to the respective group head in their allocated time slots .Then GH perform local signal processing over the collected data from their member nodes and forward to the remote sink .

When data transfer is completed, the cluster head of a group communicates their residual energy status to the GH which confirms the member of cluster-head with the maximum amount of residual energy as group GH for the next round .If cluster head finds residual energy less than threshold level then it appoints one of cluster members with maximum residual energy as cluster head for the next round and so on.

III. ENERGY CONSERVATION DEVELOPMENT

The energy used to sense the area is given by the energy consumed by the N nodes during this period of time while in the clustered scheme, the number of nodes that are activated with the same period of time is equal to the number of clusters, because each cluster employs one of its members in each interval and keeps the other nodes in sleep mode until next interval. Therefore, the consumed energy during period T is reduced compared to the energy consumed by N nodes without this coordination. We define the Energy Conservation Ratio (ECR) for each cluster as the ratio of the total amount of energy consumed by nodes belonging to the cluster during each interval (T) in two un-clustered and clustered cases for multimedia applications. Equation indicates the consumed energy during the interval T by a given node that is awakened.[1]

$$E = (Tsleep * Psleep + (Ew\_up + Ecap + Eprocess)) \quad (1)$$

Where Tsleep and Psleep are the period and power consumption for a node in sleep mode. Ew_up, Ecap and Eprocess, respectively are the energies consumed for waking up a node, capturing a picture and performing desired task. As in each cluster one of the cluster members is activated in each interval and the other members are in sleep mode, the energy consumed by nodes belonging to the cluster (with cluster size: CS) during each interval is equal to:

$$Ecluster = E + (CS - 1) \cdot Psleep \cdot T \quad (2)$$

Now using First order radio model, different assumptions about the radio characteristics, including energy dissipation in the transmit and receive modes, will change the advantages of different protocols. In our work, we assume a simple model where the radio dissipates Eelec=50 nJ/bit to run the transmitter or receiver circuitry and Eamp=100 pJ/bit/m for the transmit amplifier to achieve an acceptable. Thus, to transmit a k-bit message a distance d using our radio model, the radio expends.[7]

$$Etx(k,d)=Eelec*k+Eamp*k*d^2 \quad (3)$$

and to receive this message, the radio expends:

$$Erx(k)=Eelec*k \quad (4)$$

By this radio model energy of every node is calculated and then compared for next round processing. As by forming group of the cluster these group head communicate with the base stat ion so energy in due course conserved and performance of the network is enhanced.

IV. CONCLUSION

In this paper, grouping of clusters method for multimedia wireless sensor networks is proposed. group-membership is decided based on distance between the cluster heads and their members. Formation of cluster is based on FoV overlapping areas. The main objectives in this work are to achieve ability of coordination among groups and their respective cluster nodes in sensing and processing tasks and also to develop energy conservation in the grouped multimedia nodes. The coordination among multimedia nodes can considerably prevent wasting power avoiding redundant sensing, processing or sending similar multimedia data. Thus, it prolongs network lifetime particularly in dense networks that are usually deployed with a high number of low power, low resolution and inexpensive multimedia nodes in random manner. The proposed algorithm can work in both centralized. We select a centralized manner to perform it regarding power efficiency and enduring a negligible overhead for WMSNs.

REFERENCES

[1] Mohammad Alaei, Jose M. Barcelo-ordinas "Node Clusering Based on Overlapping FoVs for Wireless Multimedia Sensor Networks"

[2] F. Akyildiz, W. Su, Y. Sankarasubramaniam and E. Cayirci, “Wireless sensor networks: a survey,” Computer Networks (Elsevier) Journal, Vol. 38, No. 4, pp. 393-422, March 2002.

[3] Y. Chong and S. P. Kumar “Sensor networks: evolution, opportunities, and challenges,” Proceedings of the IEEE, vol. 91, pp. 1247 – 1256, 2003.

[4] F. Akyildiz, T. Melodia, and K. R. Chowdhury, “A survey on wireless multimedia sensor networks,” Computer Networks (Elsevier) Journal, Vol. 51, pp. 921-960, March 2007.

[5] I.F. Akyildiz, T. Melodia, K.R. Chowdhury, “Wireless multimedia sensor networks: applications and testbeds,” Proceedings of the IEEE, Vol. 96, no. 10, pp. 1588 – 1605, October 2008.

[6] A. Abbasi, M. Younis, “A survey on clustering algorithms for wireless sensor networks,” Computer Communications (Elsevier) journal, Vol. 30,, Issue 14-15, pp. 2826-2841, June 2007.

[7] Wendi Rabiner Heinzelman, Anantha Chandrakasan, and Hari Balakrishnan, “Energy-Efficient Communication Protocol forWireless Microsensor Networks”