EFFICIENT DATA DISSEMINATION USING GWO FUZZY IN NEURAL NETWORKS

Sivaganapathi.M[1], Paramaiyappan.M[2], Stella Rosemalar.P[3], Partha Sarathi.S[4]

[1]Assistant Professor, JP College of Engineering
[2]Assistant Professor, JP College of Engineering
[3]Assosiate Professor, JP College of Engineering
[4]Assistant Professor, Dhanalakshmi College of Engineering

---***---

Abstract— *The dispersed nature and vibrant topology of WSN have some basic requirements that include reduced energy utilization and extended network's life time. We have focused on hierarchical protocols. In such protocols the nodes are arranged in clusters .To synchronize action and route data, cluster head are selected one per cluster. We have introduced a new approach in WSN for selecting the cluster head by making use of GWO (Grey Wolf Optimization) algorithm in order to increase network's lifetime. We have used residual energy as a factor to make cluster-head. The simulation result provide network's performance on the basis of some factors including number of dead nodes, total energy consumption and the number of packets transferred to base station (BS) and cluster head(CH).And another factor included is the Artificial Neural Network (AFF) that has been used to predict the cluster head .The performance of proposed algorithm is compared with LEACH and LEACH-C based on energy efficiency and improved network lifetime. Simulation results show that the GWO Fuzzy and neural network can efficiently disseminate data with a high data delivery ratio and a minimized overhea.*

Key Words----GWO (Grey Wolf Optimization) algorithm, Artificial Neural Network (ANN), residual energy factor, cluster-head, number of dead node.

1. INTRODUCTION

Wireless Sensor Network (WSN) consists of many sensor nodes distributed randomly in a geographical area. The nodes are placed in remote and unattended environment. Further, the nodes are powered by batteries. Hence, replacement or recharging of batteries is a difficult task. So, energy efficient algorithms are suggested to reduce the discharge rate of batteries thereby increasing the lifetime of the node, in turn the network lifetime. Clustering is one such technique employed universally to achieve energy efficiency. Clustering involves two phases namely cluster formation and Cluster Head (CH) selection. Several works focus on cluster formation and CH selection. At this juncture, cluster formation is grouping of nodes which are located at single hop whereas CH selection is the process of selecting a head from the available pool of eligible nodes either randomly or based on certain factors. This leads to hierarchical network with member nodes and CH as portrayed. The member nodes send data to the CH where the data is aggregated and further transmitted to another CH or Base Station (BS). Hence, the energy consumed by the member node is relatively lesser when compared with that of CH. Especially, when the CH communicates for a long duration; its energy drainage is high resulting in partitioning of network due to the key node's (CH"s) death. To overcome this, Cluster Head Reselection (CHR) is mandate.

Further, CH reselection may be either periodic or threshold based. In periodic CHR, the node continues to be CH for a fixed interval. In such case, frequent reselection may occur when the interval is short leading to time overhead and energy consumption. Similarly, when the interval is long, it may result in network partition. Whereas in threshold based reselection, the interval depends upon the rate of energy drainage and threshold energy. So, to minimize frequent CH reselection, all the major energy drainage factors are to be considered for CH selection. Further, CH selection may be based on fuzzy logic, neural networks and other soft computing techniques due to its ability to resolve uncertainties. Fuzzy logic is widely used in prediction of CH. Fuzzy based CH selection considers the major energy drainage factors such as Residual Power of Sensor Nodes (RPSN), Distance of the Node from Base Station (DNBS), Distance of the node from Cluster Centric (DCC), Degree of Neighboring Nodes (DNN), Sensor Node Movement (SNM), Rate of recurrent Communication of Sensor Node (RCSN) etc. to select the CH. Some of the proposals are validated through hardware. Nonetheless, in the above works the time interval between two consecutive CH reselections, i.e., the reselection interval or number of rounds a node can act as CH is not anticipated. CH selection based on energy and distance are proposed. In prediction of reselection interval or number of rounds of CH based on residual energy and the distance of the node from BS is proposed. Moreover, the accuracy of reselection interval prediction relies on the inherent energy factors considered for prediction. However, the energy consumed by a node with the influence of an obstacle is not dealt.

The presence of an obstacle can be realized through Received Signal Strength Indicator (RSSI). On the other hand, the earlier works considered RSSI to estimate either location or path loss to analyze link quality. Also, RSSI is used as a metric in security of WSN .Nevertheless, none of the works considered RSSI for CH selection.

Furthermore, first order radio model is used to predict energy consumption of the node. Nonetheless, the model shows deviation in energy consumption measurement through hardware .This is due to the fact that the model fails to consider the deviation in the energy consumption by electronic circuitry. This energy consumption is based on the rating and characteristics of Radio Frequency transceiver and is product dependent. Therefore, a simple and more reliable energy prediction model is to be developed irrespective of the hardware used.

To address these issues, the following contributions are made.

(i)RSSI along with residual energy and distance of the node from Base Station are considered for CH selection. By doing so, the prediction on the expected number of rounds for a node to continue as CH would be more precise.

(ii) In addition, RSSI based energy prediction model using linear regression is proposed which has significance where practical measurement of energy is not possible.

2. RELATED WORK IN VANET

In recent years, data dissemination has been heavily researched in the context of vehicular networks. Previous Existing work either consider the highway scenario or the urban layout, however, efficient protocols must accommodate both traffic scenarios. The majority of existing protocols with different layout considerations aim at addressing the broadcast storm problem for an improved network performance in terms of coverage, data redundancy and dissemination delay. This problem is often addressed by selecting a set of vehicles as forwarding relays. Different methodologies have been utilized recently to offer efficient solutions mostly by focusing either on data redundancy or dissemination delay. In this section, we firstly review existing data dissemination protocols for highway scenarios, and secondly for urban environments. Thirdly, we discuss the major differences among the reviewed protocols from a set of perspectives correlated with target scenarios, prior assumptions, and performance evaluation.

A. Data Dissemination Protocols for Highway Scenarios

In an enhanced 1-persistance data dissemination protocol (E1PD) is introduced for vehicular networks in highway environments. E1PD enhances the classical slotted 1-persistance method, by making variations in the waiting time among receiving vehicles based on their direction. This way, the number of vehicles assigned to a single timeslot can be reduced because vehicles at nearly the same location but different direction are assigned to different timeslots. Nevertheless, the total number of timeslots is a predetermined constant that is not adapted to the road traffic condition. Thus, data redundancy can easily lead to high communication overhead due to unnecessary transmissions under high densities. Another data dissemination protocol for highways named ATENA is proposed in. It selects vehicles inside a preference zone to rebroadcast messages. Similar to, performance results show that ATENA suffers from high data redundancy especially under high-density scenarios, since many vehicles may unnecessarily participate in relaying traffic data. The idea of considering a preference zone to select forwarding vehicles is also presented in ADD protocol, which combines broadcast suppression with delay de-synchronization. Despite the reduced collisions, ADD does not show consistent data delivery. In addition, existing protocols can achieve better performance in terms of dissemination delay. Besides the utilization of a preference zone, exploiting beacons is widely considered to decrease the percentage of data redundancy in vehicular environments. In ADDHV, beacons are used solely for detecting neighbors, and the propagation efficiency is defined for further transmission control. However, and similar to ADD, ADDHV does not show an improved performance in terms of dissemination delay.

B. Data Dissemination Protocols for Urban Scenarios

The majority of dissemination protocols designed for urban vehicular networks rely on the utilization if beacons for an improved broadcast. Nakorn and Rojviboonchai propose a density-aware reliable broadcast protocol (DECA) for urban vehicular networks with adaptive beacon interval. Beaconing in DECA allows nodes to exchange their local density and identifiers of received messages with 1-hop neighbors. When a broadcast is initiated, the neighbor with the highest local density is selected as the next relay. To improve reliability, other neighbors store the message and set a waiting timer, so that another neighbor can forward the data in the case of relay failure. Although DECA is evaluated under both highway and urban scenarios, it does not consider data dissemination in different directions depending on the road layout.

ERD is another protocol which exploits beacons for relay node selection to improve urban vehicular broadcast. However, unlike DECA, ERD employs directional broadcast by considering three road layouts: straight road, curve road, and intersection. Simulation results show that ERD improves bandwidth utilization while maintaining data delivery ratio. Beacons are also utilized in TURBO to determine the status of traffic regime. A high number of beacons indicate dense traffic, while low or no beacons indicate a sparse network. Each vehicle can decide to relay messages based on the number of beacon messages received. When dense traffic is encountered, only part of the vehicles would act as relays to avoid the broadcast storm. Similarly, TrAD protocol requires beaconing to maintain the status in a one-hop neighborhood. The broadcast suppression in TrAD is senders oriented, where the decision is made by the sender to control the rebroadcast order of neighbors. A cluster classification mechanism is employed to identify vehicles belonging to each cluster.

DRIVE, AMD, and U-HyDi are three of the recent data dissemination protocols that consider both highway and urban traffic scenarios. Similar to they rely on local one-hop neighborhood information via beaconing to deliver messages under different traffic conditions. Simulation results show that these protocols can decrease data dissemination delay and overhead while maintaining a high data delivery ratio. Despite the fact that the involvement of beacons can support traffic density estimation (which is essential to determine traffic condition for efficient data dissemination), it has been proven that beaconing with a fixed period have several drawbacks on the performance of the network, such as wasted bandwidth and increased network congestion. It was shown that channel would be 80% loaded when each vehicle sends a 200-byte beacon every 100 milliseconds at the range of 300m. Therefore, it is crucial for data dissemination protocols to maintain the size of exploited beacons, in order to preserve the limited available bandwidth. Methods that utilize beacon-free approaches also exist. However, these methods often make assumptions on a fixed infrastructure. For instance Li et al. Propose the Efficient Directional Broadcast (EDB) protocol which assumes a directional repeater to operate at each road intersection. A repeater is equipped with four fixed directional antennas pointing to four road segments, in order to forward data messages to vehicles on different road segments incident to an intersection. Other examples of protocols with infrastructural assumptions are found in. In a scheduling framework is proposed to address the collision problem. To improve dissemination efficiency, a relay selection strategy is employed and space-time network coding is adopted with low detection complexity and space-time diversity. RSU is the resource that broadcasts data to the vehicles within its coverage, and vehicles can share data with their neighbors. Despite its proven delay performance, the proposed strategy does not operate in the absence of fixed infrastructure. In addition, the dissemination overhead is not considered in its evaluation.

To reduce the communication overhead and enhance data dissemination throughput in VANETs, Zeng et al. Propose a channel prediction based scheduling strategy, which achieves high scheduling efficiency under both urban and highway scenarios. However, and similar to and , the proposed strategy assumes an existing infrastructure with a set of RSUs that are connected to a control server through a wired backhaul. Each of them collects and manages vehicular information within its communication coverage.

However, most of them suffer from an increasing delay or high redundancy overhead. For example, UGAD shows an efficient performance when setting appropriate threshold values; however, data redundancy may be unnecessarily increased under high-density scenarios. This problem is eliminated in UMBP, where a multidirectional broadcast is employed at intersections to conduct the forwarding vehicle selection in different directions. The evaluation of UMBP is performed in terms of dissemination delay, reception rate, and propagation speed, while data redundancy overhead is not evaluated. Another example is the Road-Casting Protocol, which assigns different broadcast probabilities to receiving vehicles based on the distance and the link quality. Vehicles with higher probabilities have lesser waiting times before rebroadcasting.

The obtained results have proven the efficiency of Road-Casting in terms of data delivery ratio and end-to-end delay. However, the overhead under high densities is still high. Focus on data redundancy reduction by selecting the appropriate disseminators. The selection process relies on complex network metrics, which are: degree distribution, centrality and clustering, travel time and distance. Nevertheless, the measurements of these metrics require a comprehensive network analysis that is computationally expensive. The authors assume that a prior density knowledge is available to drivers based on mobility traces studies, which represents a major drawback of their proposal. Similarly, data redundancy is reduced in HBEB, where a beacon-free algorithm is employed. The algorithm is designed to form multiple backbones of relay vehicles in VANET. This formation poses an extra dissemination delay, which makes it inappropriate with safety-related applications in the context of ITS.

3. GREY WOLF OPTIMIZER FUZZY ALGORITHM

Grey Wolf Optimizer. The Grey Wolf Optimizer algorithm (GWO) is a meta-heuristic that was originated in 2014 created by Seyedali Mirjalili, and inspired basically because in the literature there was not a Swarm Intelligence (SI) technique based on the hierarchy of leadership of the Grey Wolf.

This presents aspects concerning the tuning of fuzzy controllers (FCs) by grey wolf optimization (GWO) algorithms with focus on cost-effective Takagi-Sugeno proportional-integral fuzzy controllers (T-S PI-FCs). GWO is one of the latest swarm intelligence algorithms, which has been developed by mimicking grey wolf social hierarchy and hunting habits. T-S PI-FCs are applied to servo systems, represented as non-linear processes characterized by second-order dynamics with an integral component, variable parameters, a saturation and dead-zone static non-linearity. The variable parameters of the process justify the need to design fuzzy control systems with a reduced process parametric sensitivity. Four optimization problems are defined with this regard, with the tuning parameters of T-S PI-FCs considered as vector variables and with objective functions that include the weighted output sensitivity function of the state sensitivity model with respect to process parametric variations. GWO is next employed in the minimization of these objective functions. Simulation and experimental results are given for a case study that deals with the optimal tuning of T-S PI-FCs for the angular position control of a laboratory non-linear servo system. The process gain is variable, and fuzzy control systems with reduced process gain sensitivity are offered. Energy is a valuable resource in Wireless Sensor Networks (WSNs).

The status of energy consumption should be continuously monitored after network deployment. The information about energy status can be used to early notify both sensor nodes and Network Deployers about resource depletion in some parts of the network. It can also be used to perform energy-efficient routing in WSNs. In this paper, we propose a neural network based clustering and energy efficient routing in WSN with the objective of maximizing the network lifetime. In the proposed scheme, the problem is formulated as linear programming (LP) with specified constraints. Cluster head selection is done using adaptive learning in neural networks followed by routing and data transmission. The simulation results show that the proposed scheme can be used in wide area of applications in WSNs.

A. Assumptions and Requirements

For selecting the cluster head we use GWO and ANN. Grey wolf optimizer uses the leadership hierarchy. In the leadership four types of grey wolves layers are used alpha, Beta, Delta, Omega. The nodes in the layer 1 are called as Leader, nodes in the layer 2 are called as Co-leader, the nodes in the layer 3 are called as Elder and the nodes in the layer 4 are called as Members. By this approach power consumed is diminished and the network lifetime gets increased. If the cluster has only one node in the layer 1 means, then the node will be selected as a cluster head directly. If the two node are present in the cluster, then the cluster head (CH) is selected by using Residual energy of both the node, the node which has high residual energy is elected as cluster head If the cluster has more than two nodes, then the cluster head is selected by using Gaming theory with some parameters such as Residual energy, Packet reception ratio.

Neural networks are a set of algorithms , modeled loosely after the human brain , that are designed to recognize patterns Neural network is used to predict the cluster head and it increases energy efficiency. They interrupt sensory data through a kind of machine perception, labeling or clustering raw input.

In the following we define the basic terms used in this paper:

• BROADCAST INITIATOR: is the node which originates a new data and intends distribute it to nearby node.

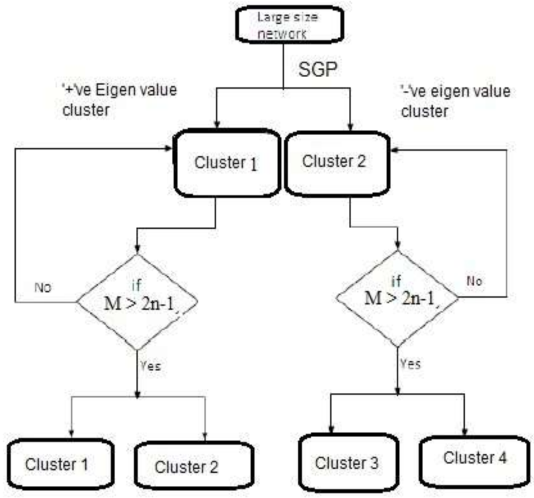
• REALY NODE: is the node which updates traffic condition before rebroadcasting a data that was originally initiated by another node.

• AREA OF EVENT (AoE): where the data is initiated to indicate the event.

• AREA OF INTREST (AoI): is the wide area in the selected area where data should deliver with highest possible ratio.

• APPROACHING NODES: the node moving towards the AoE.

• REEDING NODES: the node moving away from the AoE.



1. Find the Eigen values and Eigen vectors of the nodes

2. Partition the graph as two clusters by using positive and negative Eigen value.

If (Eigen vector (i) == positive)

Node (i) == Cluster

else

Node (i) == Cluster 2

end

After the first iteration 'n' number of clusters were formed. (n = 2 when k = 1)

3. For further cluster partitioning

Number of nodes inside the cluster (M)

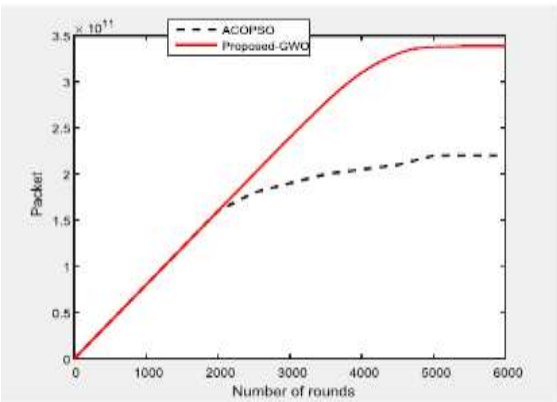
Grouping the nodes and form a cluster with less energy consumption by that maximizing the life time is an challenging task in WSNs. The two important steps in clustering are Cluster formation and Cluster Head (CH) selection. The novel and efficient clustering called Clustering using Eigen Values (CEV) is proposed in this paper with the increased lifetime of the sensor nodes using the spectral graph theory. This work uses the Laplacian matrix of spectral theory for clustering. The Eigen values of Laplacian Matrix and its corresponding eigenvector are used to group the nodes of WSN. CH is selected using fuzzy logic and constraints on energy and distance. This work is evaluated and compared with LEACH and HEED for performance comparison. The results obtained in this work show that the proposed work yields better. The grey wolves follow very firm social leadership hierarchy. The leaders of the pack are a male and female, are called alpha (α). The second level of grey wolves, which are subordinate wolves that help the leaders, are called beta (β).Deltas (δ) are the third level of grey wolves which has to submit to alphas and betas, but dominate the omega. The lowest rank of the grey wolf is omega (ω), which have to surrender to all the other governing wolves

This algorithm works by assigning membership to each data point corresponding to each cluster center on the basis of distance between the cluster center and the data point. More the data is near to the cluster center more is its membership towards the particular cluster center. Summation of membership of each data point should be equal to one. After each iteration membership and cluster centers are updated according to the formula:

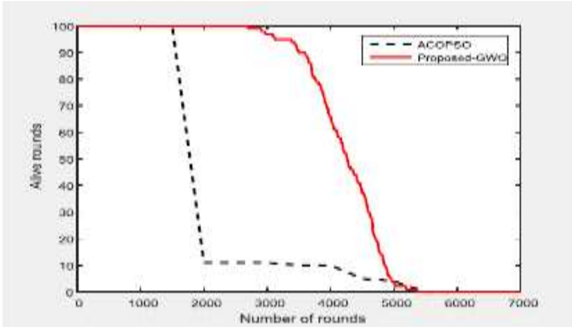
$$\mu_{ij} = \sum_{k=1} (d_{ij}/d_{ik})^{(2/m-1)}$$

Proposed Network

Setup Parameters	Value
Network Area	100,100
Base Station (x,y)	50,50 or 50,150
Number of nodes	100
Initial Energy	0.1 joule
Transmitter Energy	50*10-9
Receiver Energy	50*10-9
Free Space (amplifier)	10*10-13
Multipath (amplifier)	0.0013*10-13
Effective Data Aggregation	50*10-9
Maximum Lifetime	2500
Data packets size	4000



The comparison is done in the terms of data packets received at BS. The graph expounds that in proposed work, the amount of packets received at base station is higher than the number of packets received at base station in ACOPSO.



The alive nodes in proposed work are higher than the number of alive nodes in traditional work.

Assumptions made for this routing:

(i) Sink (Base Station) is located inside the sensor field

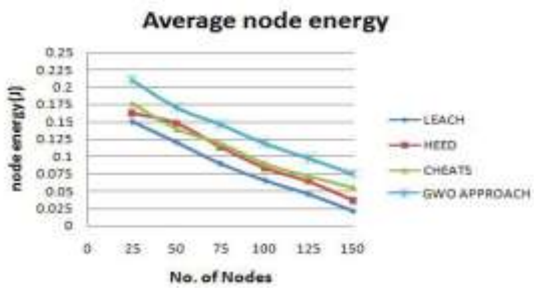
(ii) Unlimited resource is allotted for BS.

(iii) After deployment sensor nodes are unattended. So that recharging or changing of battery is not possible.

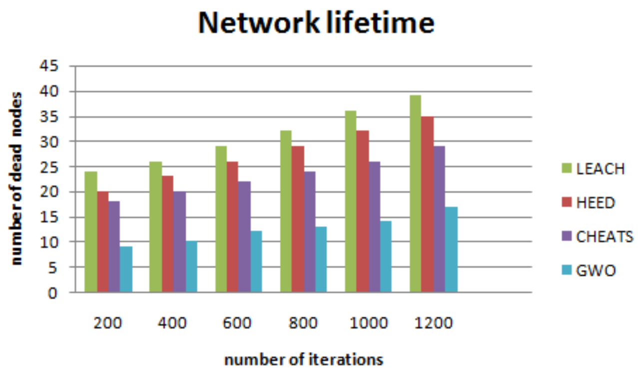
(iv) Links are asymmetric because of the mobility of the nodes.

(v) All sensor nodes are not equipped with any location finding device.

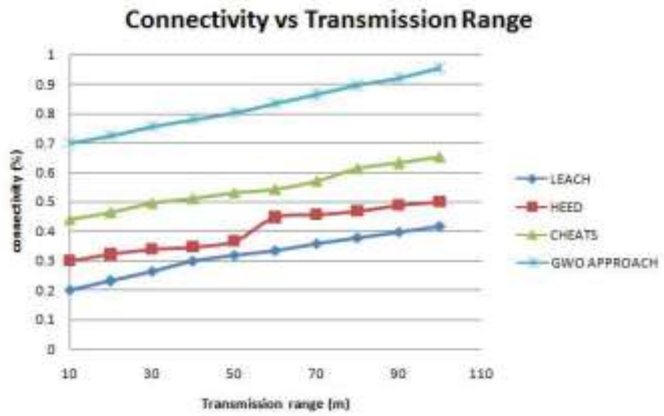
(vi)Mobility of the node is controllable and predictable.



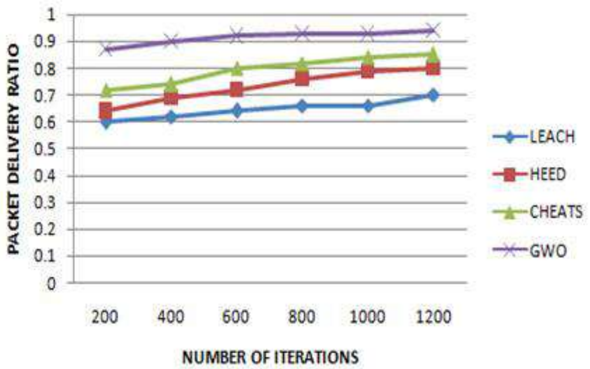
It is noticed that the power consumption is less in GWO approach compared to LEACH, HEED and CHEATS because of reduction in number of iterations and the hierarchy followed in proposed approach. Thus, the lifetime of the entire network gets increased.



It is observed that the network life time of Grey-Wolf optimization approach is increased by 10% compared to CHEATS and 12% compared to HEED and 16% compared to LEACH.



The existence of the connectivity between the nodes as strong even the transmission range gets increased.



It is observed that data packets delivered effectively in GWO approach compared with other approaches.

4. CONCLUSION

In wireless sensor network due to proper routing technique the power consumption can be reduced reasonably. Due to this, the lifetime of the entire network gets enhanced and the node which is responsible to forward the packet plays a main role in routing. In proposed Grey Wolf Optimization (GWO) approach a proper cluster head is elected using a layer based architecture that splits up the entire region into four layers, each having several responsibilities and the number of iterations is reduced compared with LEACH, HEED, CHEATS and GTDEA. This approach guaranteed that a considerable amount of reduction power consumption, thereby increasing the lifetime of the entire network. Simulations performed showed that the energy consumption, throughput and network lifetime has improved compared to other approaches.

REFERENCES

[1] Ian F. Akyildiz, Tommaso Melodia, Kaushik R. Chowdury, "Wireless Multimedia Sensor Networks: A Survey" IEEE Wireless Communications, December 2007.

[2] Ian F. Akyildiz, Tommaso Melodia, and Kaushik R. Chowdhury, "Wireless Multimedia Sensor Networks: Applications and Testbeds", Proceedings of the IEEE, October 2008.

[3] Ian F. Akyildiz, Tommaso Melodia, Kaushik R. Chowdhury, "A survey on wireless multimedia sensor networks", Computer Networks, Elsevier Science BV, 2006.

[4] I. F. Akyildiz, T. Melodia and K. R. Chowdhury, "A Survey on WirelessMultimediaSensorNetworks," ComputerNetworks, Vol. 51, No. 4,

[5] Islam T.Almalkawi, Manel Guerrero Zapta, Jamal N.Al-Karaki and Julian Morillo-Pozo, "WirelessMultimediaSensorNetworks: Current Trends and Future Directions" Sensors 2010.

[6] Ameer Ahmed Abbasi and Mohamed Younis, "A survey on clustering algorithms for wireless sensor networks", Computer Communications, Elsevier Science BV, 2007.

[7] Ossama Younis, Marwan Krunz, and Srinivasan Ramasubramanian, "Node Clustering in Wireless Sensor Networks: Recent Developments and Deployment Challenge",IEEE Network, May/June 2006.

[8] Xuxun Liu, "A Survey on Clustering Routing Protocols in Wireless Sensor Networks"Sensors 2012, 11113-11153.