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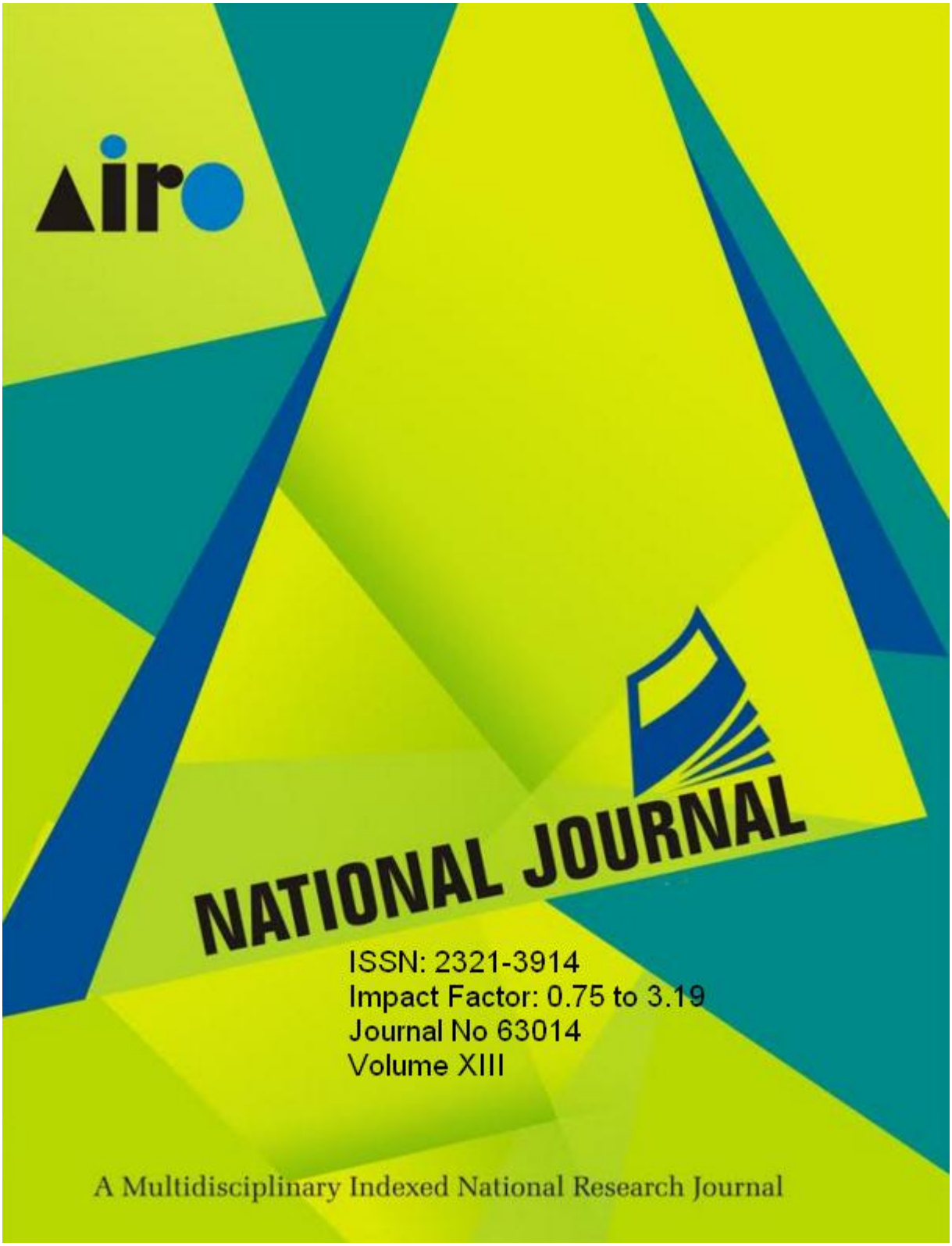

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A STUDY OF HIREACHAL CLUSTERING IN WIRELESS SENSOR NETWORK

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ABSTRACT

The hierarchical clustering is an efficient way to reduce the overall energy consumption within the cluster by performing aggregation and fusion of data. Hence, the amount of transmitting information to the base station is decreased. Clusters create hierarchical Wireless Sensor Networks (WSNs) which facilitate efficient utilization of limited resources of sensor nodes and thus extend network lifetime, reduce energy consumption of the system and provide overall system scalability.

Keywords: Wireless Sensor Networks, hierarchical routing, Clustering, clustering algorithms.

INTRODUCTION

Wireless sensor network is the collection of wireless nodes that are often randomly deployed in a targeted area overvigorously changing environments. These nodes can sense,process, and forward data to neighboring nodes and basestation (BS). Moreover, these small devices have limitedcapabilities such as small memory, low computation, lowprocessing, and most importantly small power unit (usually equipped with batteries). the sensor nodes are scattered overa large geographic area containing hundreds of nodes tomonitor a target region. As the sensed data has to be for-warded to BS for further necessary action, therefore routingbecomes important for transferring of data from node tonode or BS efficiently. the WSN has been acknowledgedas one of the significant technologies of the 21st century.A tiny, low cost device having sensors on board, connectedwirelessly with self-organizing capability, can be connectedto the Internet for controlling and monitoring environments, homes, offices, cities, and much more.

WSNs are made up of individual embedded systems that are competent of interacting with their environment through various sensors, processing information locally, and communicating this information wirelessly with their neighbors. A sensor node consists of three components: sensing, processing and communication components and can be either an individual board or embedded into a single unit. Deployment of a large number of nodes in WSNs is one of the main characteristics which makes a major difference between traditional networks & sensor networks. In a wireless medium, large number of nodes have advantages in term of connectivity and coverage but also have disadvantages in terms of increased collision and generated overheads. Grouping of sensor nodes is called acluster . Clustering is used in WSNs as it provides overall network scalability, efficient use of constrained resources that gives network topology stability and energy saving characteristics. A large number of clusters will cover the area with small size clusters and a very small number of clusters will exhaust the

cluster head with large amount of messages transmitted from cluster members

One of the most important challenges of WSNs is to develop a protocol such that numerous randomly deployed sensor nodes behave in a collaborative and organized way. While each sensor node wants to maximize its own utility function, the entire network needs balance in resource assignments. Among many proposed network routing protocols for WSNs, hierarchical routing protocols greatly contribute to system scalability, lifetime, and energy efficiency.

Various hierarchical routing protocols have been proposed with different design goals, clustering criteria and basic assumptions. To our best knowledge, all current clustering are top-down approaches. These protocols first build the upper level of clusters by selecting certain nodes as CHs, and then group the rest of nodes into the designated cluster. Many algorithms actually randomly select CHs and force re-clustering with certain conditions. Random or inefficient selection of CHs, usually results in low cluster quality. Some other algorithms focus on building optimized clusters to avoid low cluster quality, requiring however global network knowledge.

Hierarchical routing protocols offer a more feasible solution to handle large scale networks with their enhancements to better share limited wireless channel bandwidth, balance node energy consumption, and reduce communication expense By the method of CH selection, the hierarchical routing protocols can be classified into two categories: random-selected-CH protocol and well-selected-CH protocol. The former randomly selects CHs and then rotates the CH task among all nodes, while the latter carefully selects appropriate CHs and then gathers nodes under the CHs based on the network status

REVIEW OF LITERATURE

Maryam and Reza in 2015 proposed "A de centralized Energy efficient hierarchical cluster based routing algorithm for wireless sensor networks". In WSN, each sensor node reports occurred phenomena and perform local processing. These data are sent to the base station either directly or through some relay node. Finally, all data associated with a parameter will be processed and the ultimate result value is estimated fairly accurate. Here, failure of a node has almost no impact on estimated value but causes loss of coverage area and increases time for event diagnosis. Their approach in based on concept of dividing the entire WSN into several clusters and each cluster has a cluster head for managing the operation of that cluster. Cluster head ensures proper distribution of load between nodes. The energy for transmitting "L bit data" is given as Et(L, d) = L * Eelec + L * efs * d2 Where d < d0 Et(L ,d) = L * Eelec + L * empf * d4 Where d >= d0 Where d is the transmission distance, Eelec is digital electronics, efs and empf are amplifier energy factors for free space and multi path fading channel models respectively. d0 is the threshold distance that depends on the environment. The energy for receiving data by sensor node is given by Er(L) = L * Eelec Their results show that the energy consumption has been reduced and the network lifetime has been improved significantly.

Abolfazli and Mahdavi in 2014 proposed "A homogenous wireless sensor network routing algorithm: An energy aware cluster based approach".The proposed algorithm consists of three phases as 1. Network leveling phase in which the nodes of the network are placed in the region and the network will be initialized.

2. Clustering phase in which the clusters are created and an election can be made for the selection of the cluster head for each cluster. 3. Data Transmission phase in which the nodes start communicating with each other and share their information and other information. The energy consumption has been reduced to certain extent.

Zhao, Zhou and Gao in 2012 proposed "Energy efficient and cluster based routing protocol for WSN". Their work is based on the LEACH protocol. Low Energy Adaptive Clustering Hierarchy (LEACH) is the first routing protocol based on hierarchical clustering and a classical hierarchical routing protocol in WSN. It divides WSN in several clusters. The first step in this approach is the election for the selection of the cluster head. The second step is the transmission of data between sensor nodes in the network. This can be accomplished through clustering heads.The energy consumption has been reduced greatly and the network lifetime has been significantly improved

. Lee, Kong, Lee and Byeon in 2005 proposed "Cluster Based Energy Efficient Routing Protocol without Location Information for Sensor Networks". Their work is based on the LEACH protocol. They have proposed the use of Time Division Multiple Access (TDMA) for transmission of data and sharing of information between Cluster Nodes. The results show that there is a significant reduction in the energy consumption.

Nikolodakis, Kandris, Vergados and Douligerisin 2013 proposed "Energy Efficient Routing in Wireless Sensor Networks through Balanced Clustering". Their work is also based on the LEACH protocol and uses TDMA for transmission and sharing of data. For minimizing energy consumption, Gaussian elimination algorithm has been employed.The results show that the energy consumption has been reduced and network lifetime has been improved significantly. Author Yi Sun and Can Cui present a dynamic clustering routing algorithm for WSN in . In this paper, author proposed the algorithm comprised of three phases including cluster head (CH) selection, cluster setup and inter-cluster routing. Residual energy and node load are used for the cluster heads selection. Then the non-Cluster head nodes choose a cluster by comparing the cost function of its neighbor CHs. Multi-hop communication is used to communicate with cluster head and base station in the network.

Lingxia Liu and Qiang Song present a paper "A Kind of Energy-efficient Routing Algorithm for WSN Based on HQEA". a hybrid QEA-based energy efficient routing algorithm (HERA)was proposed. This algorithm is based on LEACH and PEGASIS algorithm which is used in the environment of wireless sensor networks .To minimize the distance between transmitter and receiver, this algorithm uses the hybrid quantum evolutionary algorithm (HQEA) to select the best cluster based multi-chain topology. To minimize the energy consumption, node's maximum energy and its distance from the target is considered.

Author Liang Yuan and ChuanCaiproposed load balanced routing algorithm based on uneven clustering to calculate optimal number of clusters and performing uneven clustering. Because of this, number of non CH nodes under some cluster head becomes too high which leads to death due to overload as compared to even node clustering. For this, an evaluation function will be developed, which can represent residual energy distribution of nodes and at the same time defines routing evaluation function between cluster heads in the wireless network.

Haifeng Jiang proposed a, single-hop forwarding scheme to proved the better way to consume less energy than multi-hop forwarding scheme within the communication range of the source sensor or a current forwarder. This algorithm uses free space energy consumption model. This algorithm applies the social welfare function to compute inequality of residual energy of neighbors after selecting different next hop nodes. Based on energy inequality, the method is designed to compute the degree of energy balance.

Xiao-Hui Li and Zhi-Hong Guan in the paper Energy-Aware Routing in "Wireless Sensor Networks Using Local Between's Centrality" , proposed an energy-aware dynamic routing strategy that provides balanced energy usage in wireless sensor networks to improve the lifetime of the network. Routing algorithm proposed by author uses local between's centrality to estimate the energy utilization of the nearby nodes around a given local sensing node without any need regarding global information about the network architecture or energy utilization of the entire network and in case of high traffic performs the functions like load balancing and congestion control. Because the distance between nodes are large, it centrality consumes energy more quickly, the network lifetime can be increased by redistributing energy consumption of nodes with smaller local between centrality.

HIERARCHICAL CLUSTERING IN WSNS

To achieve network scalability, high energy efficieny and prolong network lifetime in large scale WSNs, sensor nodes are often grouped into non-overlapping clusters called clustering process in WSNs. Hierarchical based routing is a two level routing where first level involves selecting the cluster heads in WSNs. The second level involves the data transmission from nodes to a base station via cluster heads. A large number of clusters will cover the area with small size clusters and a very small number of clusters will exhaust the cluster head with large amount of messages to be transmitted from cluster members.

CONCLUSION

Clustering is the most noteworthy issue for networks where resources are limited. Thus, it is mandatory to make use of the available energy efficiently. There becomes a need in wireless sensor network to successfully group the sensor nodes in to clusters. This paper is anxious with the proposal of Hierarchical Clustering for static wireless sensor network. This method employs hierarchical architecture for cluster formation in a wireless sensor network. The strange feature of this technique,compared to the existing techniques is that the election of the cluster head, the cluster nodes and the monitoring of residual energy is virtuously done by the cluster head. As the base station does not encompass in these processes, unnecessary energy wastage for long distances communication is evaded, thus dropping-down the energy usage to a considerable extent. Simulation results noticeably show that the proposed Hierarchical Clustering portrays an excellent reduction in backbone energy consumption and total energy consumption. However, the energy efficiency is improved to a great extent. It is prominent that the first node death and the final node death are significantly delayed thereby the overall lifetime of the wireless sensor network is amended by the proposed Hierarchical Clustering.

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