

Various Clustering Schemes in Wireless Sensor Network

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Abstract—Wireless sensor networks (WSN) is a network which is formed with a maximum number of sensor nodes. Sensor nodes are equipped with self-battery power through which they can perform adequate operation and communication among neighboring nodes. Maximize the lifetime of the wireless sensor network; energy conservation measures are essential for improving the performance of wireless sensor network. Clustering plays a vital role in wireless sensor network. By use of clustering schemes and optimization techniques we can minimize the power consumption in WSN and increase the lifetime of network. The major concern of clustering schemes and cluster head election techniques are surveyed in this paper.

Index Terms— Wireless Sensor network, Energy efficient clustering and network lifetime, cluster head election.

I. INTRODUCTION

A wireless sensor network(WSN) sometime called wireless sensor actuator(WSAN) are spatially distributed autonomous sensors to monitor physical of environmental condition such as temperature, sound ,pressure etc. Each sensor network node has typically many parts: a radio transceiver with an internal antenna or connection external antenna, a microcontroller, an electronic circuit for interfacing with the sensor nodes and energy source. Each node is small, lightweight and portable. Several disaster management applications requires network of sensors that can be easily deployed. In such applications wires is not practically possible. To overcome these drawback wireless sensor network are used. Wireless sensor network are fast, easy to install and maintain.

The major advantages of WSN is that they can operate in dangerous environment in which human monitoring schemes is not possible or fail. In figure 1 involves various applications of WSN. The energy source in wireless sensor network should be handled in an efficient way as it cannot be recharged if it is placed in harsh or no man environment. Transmitting the sensed data to the base station can be done using various methods which includes single-hop Transmission, multi-hop based transmission, cluster based transmission, tree based and chain based transmission.

Clustering plays a vital role in wireless sensor network. The lifetime of the sensor node (SN) can be increased if clustering techniques is being adapted in wireless sensor network (WSN).

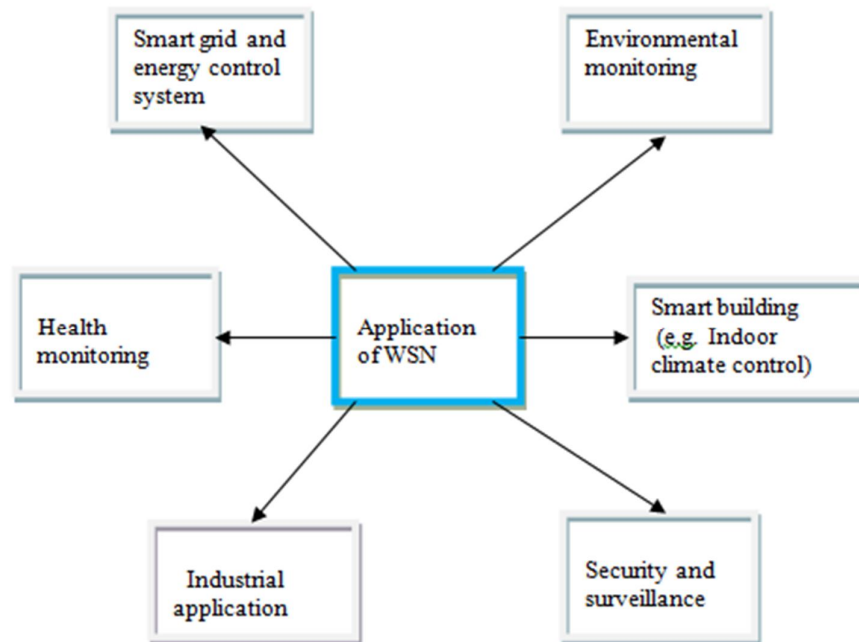


Figure 1. Application of WSN

Many clustering and routing algorithms are available for efficient data aggregation and transmission. Clustering method of data aggregation and transmission result in better lifetime as it eliminates the data redundancies. Generally in clustering networks, sensor nodes are grouped into various clusters and each cluster has a cluster-head (CH). All cluster nodes transmit the sensed data to its respective CH. CH aggregate the cluster node's data and the aggregated data is directed to the sink node.

II. GOALS OF CLUSTERING

A. Data Aggregation

The objective of data aggregation is for aggregating of data from multiple nodes to eliminate the redundant transmission and provides aggregated data to the BS. It is the best way to save energy. The CH first collects the aggregated data and then transmits to the BS.

B. Scalability

Responsibility of CH is aggregation of data, data processing, management and prevalence of information of network. At each sensor nodes the amount of size of the routing table can be reduced by localizing set up the route with the help of clustering topology compared with other type of topology, this is more scalable to tasks in the environments.

C. Network lifetime maximization

Network lifetime is the term which cannot be disregarded in WSN because sensor nodes are impel in supply of power, bandwidth of transmission.

D. Connectivity guarantee

In WSN, transmission of data to one or more base stations through the single hop or multi-hop routing. To check whether data is administered successfully or not to BS. BS is determined by the connectivity of node to next hop. If the nodes cannot transfuse with each other than the data cannot be transfer to the BS.

E. Avoidance of energy holes

The data is delivered to BS by using the multi-hop routing. The sensor nodes which are closer to the BS transmit number of packets more than the sensor nodes which are away from BS. Due to this, the nodes

nearer to BS, whole network partitioned and the nodes which are outside preventing them for sending of data to BS, nodes which are remaining some amount of energy. This concept is known as hole.

F. Load balancing

Load balancing is help for extending the network lifetime of WSN. Distribution of sensor node done even among the clusters where the data processing and intra-cluster management performed by the CH. Due to equal size of clusters, it extend the lifetime of networks and inhibits exhaustion of energy of CH.

G. Latency reduction

Transmission of data was done hop by hop, by using the routing scheme, but the data is transmitted by the CH in scheme of clustering routing. Because of reduction in hops is occurred from source to BS, so it decreases latency.

During cluster formation is not sure that all nodes are becoming a member of any of the cluster. There may be some left nodes also in the sensing region after cluster formation which is generally called as individual nodes. Such nodes require higher energy for transmitting the sense data directly to the sink node. Else such nodes need to send many control message to find the next best hop for constructing the optimal routing path. It consume more energy .so, various optimization algorithms are like particle swarm optimization (PSO), Differential Evolution (DE) used for cluster formation and cluster head election to reduce the residual node in wireless sensor network.

III. LITERATURE SURVEY

S. Selva kennedy et al., 2007[2] proposed biologically inspired clustering protocol for wireless sensor network. Sensor nodes may be deployed in hostile area; these battery powered nodes are mostly expected to operate for a relatively long period. Clustering was an approach pursued by many groups in realizing more scalable data gathering and routing. However, it was challenging to form an appropriate number of clusters with well balanced memberships. We proposed a novel application of collective social agents to guide the formation of these clusters. In order to counter the usual problems of such meta-heuristics, we to converge fast with very limited overhead. An analysis was performed to determine optimum number of clusters necessary to achieve the highest energy efficiency. In order to allow for a realistic evaluation, a comprehensive simulator involved critical components of communication stack is used. This protocol was found to ensure a good distribution of cluster heads through a totally distributed approach.

Ali Chamam, Samuel Pierre 2010[3] proposed novel distributed clustering algorithm minimizing energy dissipation and maximizing network lifetime were among the central concern when designing application and protocols for sensor networks. Clustering has been proven to be energy to be energy-efficiency in sensor networks since data routing and relaying are only operated by cluster heads. Besides, cluster heads could process, filter and aggregate data sent by cluster member, thus reducing network load and bandwidth. Where cluster heads are elected following a three-way message exchange between each sensor nodes and its neighbors. Sensor's eligibility to be elected cluster head was based on its residual energy and its degree. This protocol had a message exchange complexity of $O(1)$ and a worst -case convergence time complexity of $O(N)$.

Fuad Bajaber, Irfan Awan 2011[4] proposed an adaptive clustering protocol for wireless sensor networks. Which was called adaptive decentralized re-clustering protocol (ADRP).In ADRP the cluster head and next heads are elected based on residual energy of each nodes and the average energy of each cluster? This clustering algorithm was a technique used to reduce energy consumption. It could improve the scalability and lifetime of wireless sensor network.

Selim Bayrakl, Senol Zafer Erdogan 2012 [5] presented genetic algorithm based method (GABEEC) was proposed to optimize the lifetime of wireless sensor network. The proposed method was a cluster based approach like LEACH. Genetic algorithm was used to maximize the lifetime of the network by means of rounds. The method had two phases which are set-up and steady-state. In the set-up phase, the clusters were created and are not changed throughout of the network. The cluster not created for each round. In each round, there are static cluster with dynamically changing cluster heads.

Zhu Yong, Qing Pei 2012 [6] proposed energy-efficient clustering routing algorithm based on distance and residual energy for wireless sensor networks based on classic clustering algorithm LEACH, a distance energy cluster structure algorithm consider both distance and residual energy of nodes was presented in the

dissertation, which improve the process of data transmission. It reduce the adverse effect on the energy consumption of the cluster head, resulting from the non-uniform distributions of nodes in network and avoid the direct communication between the base station and cluster head ,which ay has low energy and far away from the base station. The result of simulation indicate that the improved algorithm effectively balance the energy consumption, prolongs 31% of the lifetime, reduce 40% of the energy consumption and had a better performance than the original LEACH protocol.

Neeraj Kumar et.al 2014[7] proposed automata-based energy efficient heterogeneous selective clustering scheme for WSN. Automaton was assumed to be located on each sensor node. There were two types of sensor nodes (SNs), normal and advanced. Based upon the weighted election probability (WEP) of each group of SNs. Cluster heads (CHs) were selected among the groups of SNs by the automaton. Automaton at each SN received penalty from the environment based upon WEP of different SNs. The learning automata-based energy efficient clustering algorithm was also proposed .Finally, first node die (FND) and last node alive (LNA) are for the measurement of lifetime of network field. Using these parameters, we had evaluated the performance of the proposed scheme in different networks scenarios in comparison with the well-known existing protocols like LEACH, LEACH-SC and SEP. The results obtained show that proposed scheme yields 5.89% improve in lifetime and 21.14%improvement instability in comparison to LEACH, LEACH-SC and SEP.

Manal Abdullah,Hend Nour Eldin et al., 2015 [8] Presented Clustering is one of the most effective techniques used to solve the problem of energy consumption in WSN. Grid based clustering had proven its efficiency especially for high dynamic networks. The grid's strategy used in this research was implemented on dense network and divided the networks area into multiple grid cells with different densities i.e., high, low, and empty. Then grids were combined to form clusters as normal and advanced clusters. Cluster head was elected for each cluster which was based on high energy. This new suggested strategy was implemented and tested using MATLAB. The result shows that this suggested strategy worked well at 150 nodes WSN and grid size between 5-10 units where the network lifetime is 633 seconds approximately

J. RejinaParvin and C. Vasanthanayaki 2015 [9] proposed Particle swarm optimization (PSO) based effective clustering in wireless sensor networks. In the existed optimized energy efficient routing protocol (OEERP), during cluster formation some of the nodes were left without being a member of any of the cluster which results in individual nodes formation. Such residual nodes forward the sensed data either directly to the base station or by findings the next best hop by sending many control messages hence reduced the network lifetime. The proposed enhanced-OEERP (E-OEERP) reduced such individual nodes formation and improved the overall networks lifetime when compared with the existing protocols. It could be achieved by applying the concepts of PSO and gravitational search algorithm (GSA) for formation of cluster and routing. For each cluster head (CH), a supportive node called cluster assistant node was elected to reduced the overhead of the CH. With the help of PSO, clustering was performed until all the node become a member of any of the cluster. This eliminates the individual nodes formation which result in comparatively better network lifetime.

IV. CONCLUSION

In this paper we have survey various clustering schemes. The crucial objective of the clustering schemes design is to retain the sensors working for a long time for increase network's lifetime. For better performance we can minimize the energy consumption, prolong the network lifetime by the use of optimization techniques for clustering.

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