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MAXIMIZING THE LIFETIME OF COGNITIVE SENSOR NETWORK USING CLUSTER HEAD

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ABSTRACT

In this paper a novel method is proposed to enhance the lifetime of the nodes by introducing clusters which communicate to the main fusion center of the cognitive sensor network. Each sensor sends its spectrum sensing result to the cluster head the node which is nearer to the fusion center is selected as cluster head. The cluster heads sends its decision to the main fusion center which makes the final decision. The proposed method is tested with a simulation scenario of three clusters with a total of thirty sensing nodes and a main fusion center. The results simulated using NS-2 shows that there is a reduction in consumed energy in the proposed network model when compared with the Parallel distributed spectrum sensing network model. The percentage remaining energy in the proposed model is 86.9646 and that of Parallel distributed spectrum sensing network model is 81.4277. Since the remaining energy in the proposed model is more ultimately this would lead to the maximization of it’s life time.

Keywords: cognitive sensor nodes, cluster head, fusion center (FC).

1. INTRODUCTION

Cognitive Radio Sensor Network has recently attracted a large amount of attention due to its advantage of dynamic spectrum access which provides reliability in terms of communication and enhances energy conservation potential in sensor network [1]. Each node in a CSRN is typically equipped with a sensors having cognitive capability for communication purpose. Preserving the consumed energy of each node is an important goal that must be considered when developing any protocol for cognitive radio sensor networks. To satisfy these requirements, different types of solutions have been proposed in the past that exploit the tradeoffs among energy, accuracy, and latency. Among many solutions, one of the solutions uses cluster selection, where sensor nodes equipped with cognitive radios are clustered according to application-specific parameters. Sensors in cluster networks can then co-operate to sense and process a physical phenomenon. Clustering of sensors helps in scalability of network and conserves energy to a large extent. Much of work in this regard has been done [2].

In the CRN networking paradigm SUs use CRs to access licensed spectrum bands in an opportunistic manner using Dynamic Spectrum Access (DSA) without interfering with the communication of licensed users or Primary Users (PUs) [7]. The CH is responsible for not only the general request but also for receiving the sensed data of other sensor nodes in the same cluster and routing (transmitting) these data to the sink. Therefore, the energy consumption of the CH is higher than that of other nodes. In order to balance the energy consumption for elongating the lifetime of this WSN, using the CH in a cluster is an alternate for sensor nodes. Therefore, the CH selection manner will affect the lifetime of this network [8]. The different application scenario context will follow the different definitions of lifetime. An important feature of sensor network is energy efficiency and to extend the network’s lifetime, battery source of each sensor in a network which should be intelligently used so that minimum amount of energy consumption is made [9].

In a centralized approach every sensor sends data to the base station and thus consumes large amount of energy as the transmission distance is much larger. Using clustering approach, first data is transmitted to cluster head of each cluster and then that data is further transferred to the base station. Therefore much of the work load of base station is distributed between cluster heads. Other than scalability, clustering helps in reducing routing table information [2].

The power consumption of wireless communication between two nodes is based on the transmission distance, which has an exponential increment with the distance. Therefore, the routes of the data transmission to the sink will affect the energy consumption. Since the hierarchical architecture provides more flexibility to handle the data routing problem, it is applied extensively to the WSNs [4].

A WSN consists of a number of sensor nodes and a sink. Grouping sensor nodes into cluster has been widely pursued by the research community in order to achieve the network scalability objective. In each cluster, a sensor node is elected, termed as the CH. The CH is responsible for not only the general request but also receiving the sensed data of other sensor nodes in the same cluster and routing (transmitting) these data to the sink. Therefore, the energy consumption of the CH is higher than of other nodes. In order to balance the energy consumption for elongating the lifetime of this WSN, the CH in a cluster is alternate among sensor nodes. Therefore, the CH selection manner will affect the lifetime of this network. The different application scenario context will follow the different definitions of lifetime [5]. In this paper a novel method has proposed in cognitive wireless sensor network using clusters for reducing consumed energy, path loss and false alarm for detection purpose.

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2. LITERATURE SURVEY

a) Maximize the lifetime of networks

A novel approach based on fuzzy logic systems to analyze the lifetime of a wireless sensor network. Here are two basic sensor placement schemes: square-grid and hex-grid. The two fuzzy logic systems of (FLSs) (a singleton type-1 FLS and an interval type-2 FLS) are designed to perform lifetime estimation of the sensor network**.** Distributed algorithms to compute an optimal routing scheme that maximizes the time at which the first node in the network drains out of energy. The resulting algorithms have low computational complexity and are guaranteed to converge to an optimal routing scheme that maximizes the network lifetime.

b) Energy efficient using clusters

A wireless cognitive radio sensor network is considered, where each of the sensor node is equipped with cognitive radio. As energy consumption is the main problem when using sensors therefore a new clustering algorithm is developed according to which group of nodes form cluster having a single cluster head. Each cluster has balanced energy which prolongs overall lifetime of CRSN. Cluster heads are rotated, depending on a threshold value, in such a way as to improve the lifetime of a cluster. As new cluster head is selected immediately whenever energy of old cluster head drops to certain threshold thus improves sensing results by CRSN nodes with minimum number of faulty decisions [2]. Simulation results demonstrate working of schemes proposed and compares the pros and cons of each scheme.

c) Existing method

Figure-1 shows the parallel distribution spectrum sensing network model with Fusion center (FC).

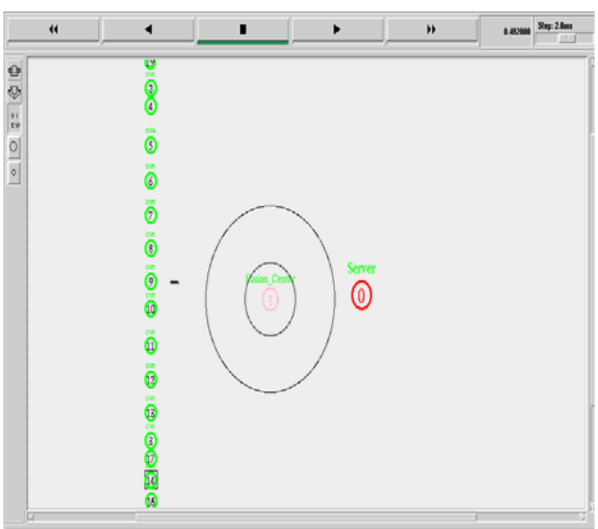

Figure-1. Distributed spectrum sensing network model with fusion center.

In this existing method the sensor nodes arranged in a parallel order this sensing results sends to the fusion center then its takes final decision sends to the server. If increased the number of nodes in this scenario possible to increase the consumed energy and false alarm occurred.

The analyzed result for this existing method the consumed energy is produced 81.42% for using NS2 calculation from the initial energy 100J.

3. PROPOSED METHOD

In the proposed method the cluster heads are introduced in the CR WSN scenario**.** This minimizes the consumed energy by reducing the path loss and also reduces the false alarm. Fusion center is introduced in between the sensor nodes and server as shown in Figure-2.

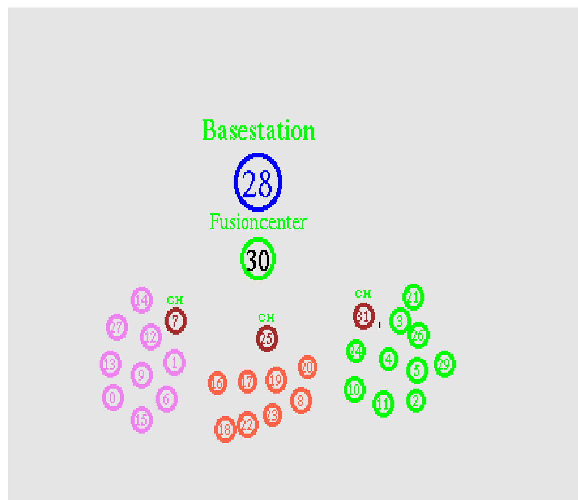

Figure-2. Cluster scenario with Fusion center.

The fusion center plays the main role in final decision making. Here cluster head and fusion centers are used to reduce the consumed energy, path loss and false alarm. Since there is a redetection in energy consumption, the lifetime of the network is increased.

The fusion center (FC) is placed in between cluster head and the server. The cluster heads can be selected depending upon the nearest node, that means which node is nearer to the fusion center that will be selected as a cluster head. CR sensors send the data to the cluster head. Cluster head collects all the spectrum information of the network which will then be given to the fusion center. Fusion center collects these and takes a final decision using fusion methods. Based on the decision made it will filter the spectrum that is available for primary users with the help of filter methods.

Performance analysis of the CR WSN arranged in clusters with a cluster head for distributed spectrum sensing by the proposed method is done. The performance analyzes is done using the network simulator NS-2. Here out of 32 nodes, the nodes 7, 25 & 31 are selected as a cluster heads. The cluster heads are shown as dark circles

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in Figure-1. Node 30 is the fusion center and node 28 is the base station. Figure-1 shows the proposed scenario.

4. SIMULATION RESULTS

Figure-3 shows the cluster heads and the collected data from the sensors.

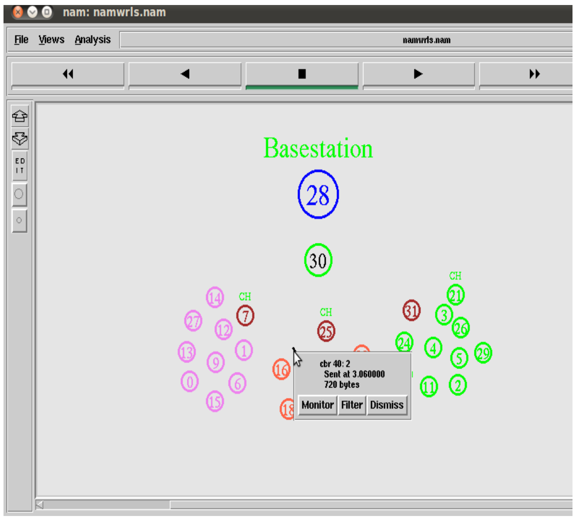

Figure-3. Selection of cluster head.

The cluster head selection depends upon the nearest node of the fusion center. Here each node is assigned an energy of 100**J** the consumed energy and remaining energy can be analyzed from this initial energy. In this analysis residual energy is calculated by taking the remaining energy form every node involved node in this scenario.

Table-1. Comparison table for using cluster and parallel methods.

Methods	Remaining Energy(J)	Consumed Energy (J)	Remaining Energy(J) in percentage
Spectrum sensing method using clusters with FC	2782.87	417.131	86.9646%
Parallel distributed spectrum sensing method using FC	2605.69	594.313	81.4277%

The comparison of consumed energy and remaining energy between cognitive radio wireless sensor networks using cluster and parallel distributed methods is shown in Table-1.

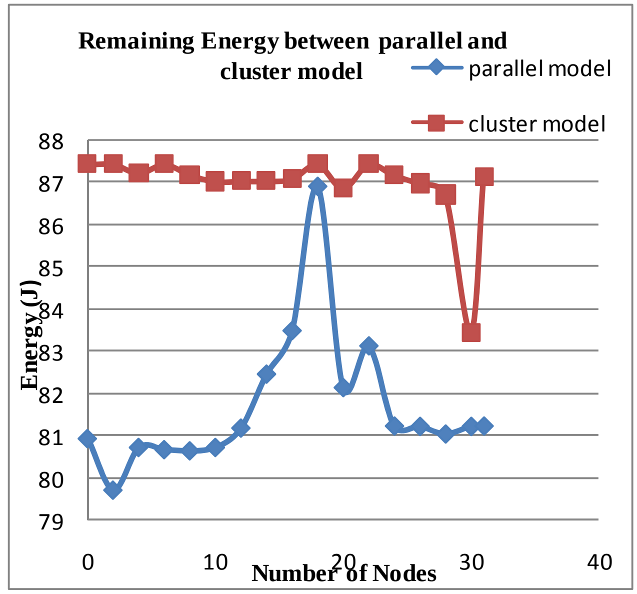

Figure-4. Comparison graph for both methods.

Figure-4 is a graphical comparison between the remaining energy with parallel model and cluster model of a CR WSN. Here X-axis shows the number of sensor nodes and Y-axis shows the remaining energy [J].

5. DISCUSSIONS

Performance analysis of CR WSN arranged in cluster for distributed spectrum sensing with the proposed fusion centers is done. The cluster head is collecting the data from cognitive sensors. After Based on the data given by the cognitive sensor, the cluster head take the first level decision which they then send to the main fusion center. The main fusion center based on these received first level decisions, make the final decision and communicate that to the server. Here the introduction of the clusters reduced the path loss since a group of sensors is connected to one cluster head and the rest are connected to the other cluster heads. Hence there is an increment in the remaining energy which leads to maximization of life time.

The performance analysis of the proposed CR WSN with clusters format for 32 sample nodes arranged in a cluster manner can be done by comparing the energy consumed and remaining energy in the network by the method, in which the CR sensors directly communicate to the fusion center with that of the proposed method, in which the CR sensors communicate to the cluster head and the cluster head in turn communicates with the fusion center.

The method, in which the CR sensors directly communicate to the fusion center (Parallel distributed spectrum sensing method) results in 2605.69**J** of remaining energy with an amount of 594.313**J** of energy consumed for a network of 32 nodes. The proposed method, in which the CR sensors communicate to the cluster head and the cluster head in turn, communicates with the fusion center results in 2782.87**J** of remaining energy with an amount of 417.131**J** of energy consumed for a network of 32 nodes. The proposed method yields 86.96% of remaining energy against 81.42% of remaining energy produced by the method in which the CR sensors directly communicate to the fusion center. Since the energy remaining in the proposed method is considerably more than the parallel distributed spectrum sensing method, the goal of maximizing the lifetime of the cognitive sensor network has been achieved.

6. CONCLUSIONS & FUTURE WORK

The problem of using multiple fusion centers for cooperative spectrum sensing is considered, in which the fusion channels run from sensors to cluster heads which are in turn connected to the main fusion center. Two different cognitive sensor network models are examined here. They are: (1) Sensor network with parallel distribution of sensor nodes. (2) Sensor network with cluster heads. Their performance on the lines of consumed energy and remaining energy was analyzed.

The initial simulation done, shows that there is a definite possibility of the network life time to be increased by the introduction of cluster heads with sensor nodes and the main fusion center. Possible future work could include the performance analysis of different cognitive sensor network models like models with decision nodes, sub nodes acting as helper nodes with cluster format. The design complexity and cost impact would also be an important aspect of future analysis.

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