PORTABLE DATA GATHERING WITH LOAD BALANCED CLUSTERING USING SENCAR

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Abstract: In this paper, a three layer framework is used for collecting mobile data in Wireless Sensor Networks. The three layers include Sensor layer, Cluster Head layer and SenCar layer known as Mobile Collector layer. In this three layer framework we use Load Balanced Clustering and Dual Data Uploading which is referred as LBC-DDU. The objective of this paper is to reduce the delay in gathering the mobile data and to increase the lifetime of the network. A load balanced clustering algorithm is used in the Sensor layer for the sensors to self organize themselves into clusters. Inorder to balance the work load and facilitate dual information Uploading it generates a Cluster Head in every cluster. The connectivity among the clusters is assured by the transmission range between the inter clusters. Using a Cluster Head within a cluster saves energy in inter-cluster communications. The information from the Cluster head is given to the SenCar through transmissions from the inter-clusters. SenCar is equipped with two antennas which help in simultaneous uploading of data to SenCar at the Mobile Collector layer. The polling points in each cluster are carefully selected for the path planning of SenCar to fully utilize the dual data uploading technique. SenCar gathers data from the cluster head and transport data to data sink from each selected polling points. The results reveals that when each cluster has its own cluster head it saves energy per node and saves energy per cluster head, and also the delay in data collection is reduced.
Keywords: SenCar; Cluster Heads; mobile data gathering; polling points; inter-cluster transmissions.

I. INTRODUCTION

A review of LBC-DDU system is portrayed in the figure, which comprises of three layers: sensor layer, cluster head layer and SenCar layer as appeared in figure 3. The sensor layer is the base and fundamental layer. For simplification, we tend to don't fabricate any presumptions on distribution of sensor or capability of node, similar to area mindfulness. Every sensor is thought to have the capacity to communicate just with its neighbors, i.e., the nodes inside of its transmission range. During initialization, sensors are self-composed into clusters. Every detecting component chooses to be either a cluster head or a cluster member in an extremely appropriated way as appeared in figure 1. At last, sensors with higher residual energy would get to be cluster heads and every cluster has at most M cluster heads, where M is a system parameter. For comfort, the different cluster heads inside a cluster region unit known as a cluster head group (CHG), with each cluster head being the companion of others. The algorithmic guideline builds clusters determined each sensor in an exceedingly cluster is one hop faraway from at least one cluster head. The advantage of such association is that the intra-cluster collection is restricted to a single bounce. For the situation that a sensor might be secured by different cluster heads in a CHG, it can be alternatively partnered with one cluster head for balancing the load.

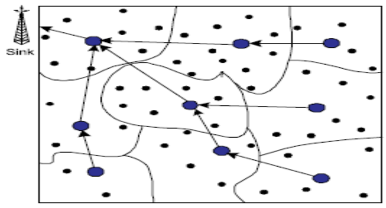


Fig.1. Sensor Clustering.

To keep away from collisions during data collection, the CHG receives time-division-multiple access (TDMA) based method to arrange interchanges between sensor nodes. Directly after the cluster heads are chosen, the nodes synchronize their nearby clocks by means of signal messages. For instance, every one of the nodes in a CHG could modify their neighborhood clocks based on that of the node with the most highest residual energy. After nearby synchronization is done, a current scheduling plan can be received to accumulate data from cluster individuals. Note that just intra-cluster synchronization is required here because of the fact that information are gathered by means of SenCar. On account of imperfect synchronization, some hybrid methods to join TDMA with contention based access protocols (Carrier Sense Multiple Access (CSMA)) that listen to the medium before transmitting are required. For instance, half breed protocols like Z-MAC can be used to upgrade the strengths and balance the shortcomings of TDMA and CSMA. Upon the entry of SenCar, each CHG transfers buffered information by means of MU-MIMO interchanges and synchronizes its neighbor clocks with the worldwide clock on SenCar through affirmation messages. At last, periodical re-clustering is performed to pivot cluster heads among sensors with higher esidual energy to abstain from emptying energy out of cluster heads.

The cluster head layer comprises of all the cluster heads. As a fore specified, inter-cluster sending is just used to send the CHG data of every cluster to SenCar, which contains a identification list of various group heads in a CHG. Such data must be sent before SenCar withdraws for its data gathering visit. After getting this data, SenCar uses it to figure out where to stop inside of every cluster to gather information from its CHG. To ensure the availability for inter cluster communication, the cluster heads in a CHG can agreeably convey copied data to accomplish spatial diversity, which gives dependable transmissions and energy saving. Additionally, group heads can likewise alter their output power for a desirable transmission range to guarantee a specific level of connectivity among clusters.

The top layer is the SenCar layer, which for the most part oversees mobility of SenCar as appeared in figure 2. There are two issues at this layer. To begin with, we have to decide the positions where SenCar would stop to correspond with cluster heads when it comes to the cluster. In LBC-DDU, SenCar corresponds with cluster heads through single-hop transmissions. It is outfitted with two antennas while every sensor has a single antenna and is kept as basic as could reasonably be expected. The activity example of information uploading in a cluster is many to-one, where information from various cluster heads makes a beeline for SenCar. With two receiving antennas, every time SenCar makes double information uploading at whatever point conceivable, in which two cluster heads can upload information at the same time. By processing the got signals with channels based on channel state data, SenCar can effectively separate and translate the data from particular cluster heads.

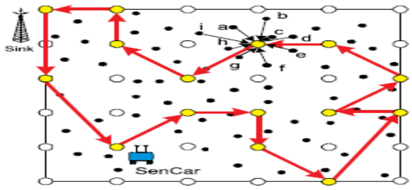


Fig.2. SenCar layer.

To gather information as quick as could be expected under the circumstances, SenCar ought to stop at positions inside a cluster that can accomplish greatest limit. In principle, since SenCar is versatile, it has the flexibility to pick any favored position. Notwithstanding, this is infeasible practically speaking, since it is difficult to evaluate channel conditions for every possible positions. In this manner, we just consider a limited arrangement of areas. To moderate the effect from dynamic channel conditions, SenCar measures channel state data before every information accumulation visit to choose candidate locations for information gathering. We call these possible areas SenCar can stop to perform simultaneous information gathering polling points. Indeed, SenCar does not need to visit all the polling points. Rather, it computes some polling points which are open and we call them selected polling points. Likewise, we have to decide the grouping for SenCar to visit these chosen polling points such that information gathering delay is minimized. Since SenCar has pre-information about the areas of polling points, it can locate a decent direction by looking for the most brief course that visits each chosen polling point precisely once and after that comes back to the data sink.

The proposed structure means to accomplish incredible energy saving and reduce data collection latency, which has the potential for various sorts of information services.Though conventional designs of WSNs can be used for low-rate information services, more detecting applications these days require top quality pictures and sound/video recording, which has turned into a staggering pattern for next generation sensor designs. For instance, in the situation of military guard, sensors deployed in observation missions need to transmit back superior quality pictures to distinguish threatening units. Delays in collecting detected information may not just uncover sensors or mobile collector to enemy reconnaissance additionally devalues the time estimation of accumulated knowledge. Utilizing MU-MIMO can significantly accelerate data gathering time and lessen the overall latency. Another application situation develops in catastrophe rescue. For instance, to battle forest fire, sensor nodes are normally sent thickly to screen the circumstance. These applications typically include many readings in a brief period (a lot of information) and are unsafe for person to physically gather detected information.

A portable collector equipped with numerous antennas beats these challenges by reducing information gathering delay and reaching risky regions not open by individual. In spite of the fact that utilizing portability might lengthen the moving time, information gathering time would get to be predominant or if nothing else similar to moving time for some high-rate or thickly deployed detecting applications. Likewise, utilizing the portable information collector can effectively acquire information even from disconnected regions and insurance that the greater part of the generated information are gathered.

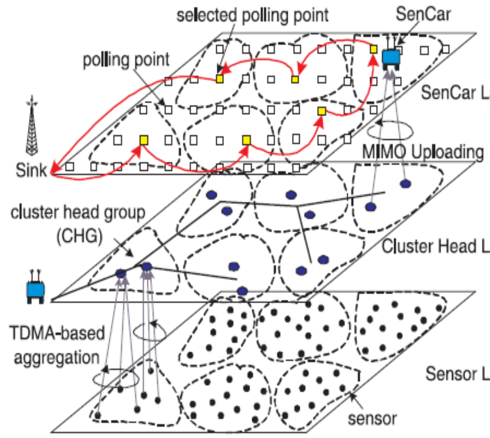


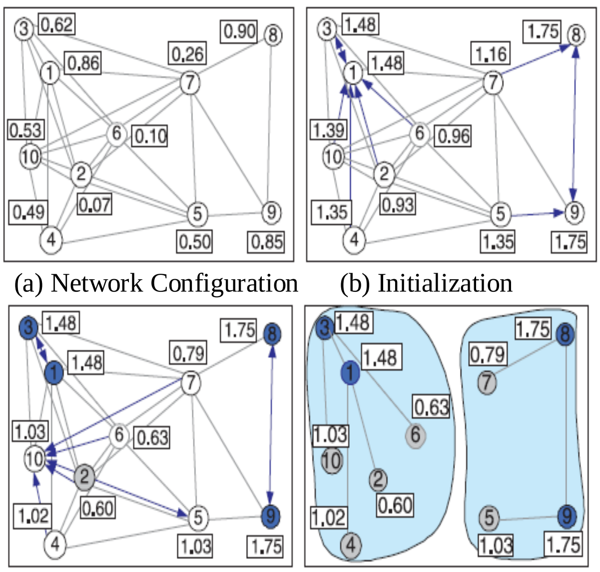
Fig.3.Architecture of three layer framework.

II. METHODOLOGY

In this segment, we display the disseminated load balanced clustering algorithm at the sensor layer. The key operation of clustering is the selection of cluster heads. To draw out system lifetime, we actually expect the chosen cluster heads are the ones with higher residual energy. Henceforth, we utilize the rate of residual energy of every sensor as the initial clustering priority. Accept that an arrangement of sensors, indicated by S = (s1, s2, . . . , sn) are homogeneous and each of them freely makes the choice on its status taking into account nearby data. Subsequent running the LBC algorithm, every cluster will have at most M ($\geq$ 1) cluster heads, which implies that the size of CHG of every cluster is close to M. Every sensor is secured by no less than one cluster head inside a cluster. The LBC algorithmn is involved of four stages: (1) Initialization (2) Status claim (3) Cluster forming and (4) Cluster head synchronization as appeared in figure 4. Next, we depict the operation through an example in Fig 4, where a sum of 10 sensors (plotted as numbered circles in Fig) is marked with their initial priorities and the availability among them is appeared by the connections between neighboring sensors.

A. Initialization Phase

In the initialization stage, every sensor familiarizes itself with every one of the neighbors in its vicinity. In the event that a sensor is a separated node (i.e., no neighbor exists), it claims itself to be a cluster head and the cluster only contains itself. Something else, a sensor, say, si, first sets its status as "tentative" and its beginning need by the rate of residual energy. At that point, si sorts its neighbors by their initial priorities and picks M-1 neighbors with the highest initial priorities, which are briefly regarded as its candidate peers. We indicate the arrangement of all the candidate peers of a sensor by A. It infers that once s_i effectively claims to be a cluster head, then the candidate peers also becomes the cluster heads, and every one of them frame the CHG of their group. S_i sets its need by summing up its introductory priority with those of its candidate peers. Thus, a sensor can pick its great companions alongside its status choice. Fig. 4b portrays the initialization phase of the illustration, where M is set to 2, which implies that every sensor would pick one neighbor with the most noteworthy introductory need as its candidate peer. We utilize the out-going arrow to demonstrate the decision of every sensor. For example, s_8 is chosen to be the peer of s_7 since it is the one with the highest initial priority among every one of the neighbors of s_7. Likewise, s7 sets its need to the entirety of the beginning needs of s_7 and s8.



(a) Network Configuration (b) Initialization

(c) Status Claim (d) Cluster Forming

Fig.4. Load Balanced Clustering Algorithm.

B. Status Claim

In the second stage, every sensor decides its status by iteratively redesigning its neighborhood data, forgoing instantly guaranteeing to be a cluster head. We utilize the node degree to control the greatest number of iterations for every sensor. Whether a sensor can at last turn into a cluster head principally relies on upon its need. In particular, we segment the need into three zones by two limits, τ h and τ m (τ h > τ m), which empower a sensor to announce itself to be a cluster head or member, separately, before achieving its greatest number of iterations. In the midst of the cycles, once in a while, if the need of a sensor is more essential than τ h or not as much as τ m differentiated with its neighbors, it can rapidly pick its last status and quit from the iteration. We mean the potential group heads in the area of a sensor by a set β. In every emphasis, a sensor, say, si, first tries to probabilistically incorporate itself into si.β as a conditional cluster head in the event that it is not in as of now. Once successful, a packet incorporates its node ID and need will be conveyed and the sensors in the vicinity will include si as their potential cluster heads after accepting the packet. At that point, si checks its present potential cluster heads. In the event that they do exist, there are two cases for si to settle on the last status choice; generally, si would stay in the speculative status for the following round of iteration.

C. Cluster Forming

The third stage is cluster forming that chooses which cluster head a sensor ought to be connected with. The criteria can be portrayed as follows: for a sensor with tentative status or being a cluster member, it would haphazardly associate itself with a cluster head among its candidate peers for burden equalization reason. In the uncommon case that there is no cluster head among the candidate peers of a sensor with conditional status, the sensor would assert itself and its present candidate peers as the cluster heads. Fig. 4 d demonstrates the last aftereffect of clusters, where every cluster has two cluster heads and sensors are partnered with various cluster heads in the two clusters. In the event that a cluster head is running low on battery energy, re-clustering is required. This procedure should be possible by conveying a re-clustering message to all the cluster members. Cluster members that get this message switch to the initialization phase to perform another round of clustering.

D. Synchronization among Cluster Heads

To perform information gathering by TDMA methods, intracluster time synchronization among built up cluster heads ought to be considered. The fourth stage is to synchronize neighbourhood checks among cluster heads in a CHG by guide messages. To start with, every cluster head will convey a reference point message with its beginning need and nearby clock data to different nodes in the CHG. At that point it analyzes the got guide messages to check whether the need of a reference point message is higher. In the event that yes, it conforms its neighbourhood clock as indicated by the timestamp of the signal message. In our structure, such synchronization among cluster heads is just performed while SenCar is gathering information. Since data aggregation is not amazingly visit in most convenient data gathering applications, message overhead is certainly sensible within a cluster.

III. RESULT AND DISCUSSION

we assess the execution of our structure and contrast it with different plans. Since the principle center of this paper is to investigate different decisions of information gatheing plans, for reasonable examination, we accept every one of the plans are executed under the same duty cycling MAC technique. The main plan for comparison is to hand-off messages to a static data sink in multi-hops and we call it Relay Routing. Since nodes with higher residual energy give more robustness and error immunity, sensors select the following jump neighbor with the most elevated residual energy while sending messages to the sink. Once a few nodes on a routing path devour an excess of energy, an option route will be evaded to circumvent these nodes. Thus, the relay routing technique can give load balance among nodes along the routing way. The second plan to look at depends on Collection Tree Protocol. In CTP, the expected number of transmission (ETX) is utilized as a routing metric and the route with a lower ETX brings priority over routes with higher ETX. For straightforwardness, we accept ETX is proportional to transmission separations between nodes. This supposition is sensible since utilizing fixed power for more transmission separation would bring about attenuated receiving power and possibly expand error likelihood and expected number of transmissions. In light of this metric, we set up a gathering tree established at the static data sink at the source (0, 0). Every node advances messages along the way with the most reduced ETX towards the sink. Any broken connections created by nodes drained battery energy would lead to large ETX and are maintained a strategic distance from in routings.

Besides, we present two plans that sort out nodes into clusters and transfer messages to the static information sink by multi-hop transmissions. The third plan to think about is clustered SISO in which sensors structure into groups with a solitary cluster head. Information messages are united at the cluster heads and transferred to the static information sink in multi-hops by SISO interchanges. By the same token, we can extend the third plan to clustered MIMO which permits MIMO interchanges between the cluster head. Then again, we additionally incorporate the fifth plan called portable SISO which is the customary route for portable information gathering, where SenCar stops in every cluster for information collection and transfers information to the sink after every one of the groups have been visited. The last plan is our proposed LBC-DDU structure (signified by mobile MIMO for clarity) that chooses different clusters heads to empower MUMIMO transferring to SenCar in every cluster.

We create a simulator in NS2 and examine the parameter settings in the accompanying. An aggregate of n sensors are haphazardly scattered in a $l \times l$ field. The static information sink is situated at (0,0). There are an aggregate of n_p polling points consistently disseminated in the field. The sensor transmission range R_s is 40 m. Every sensor has introduced an AA battery of 1,500 mAh. To gauge energy utilizations for SISO, we utilize this model, i.e., $e_t = (e_1 d_r^{\alpha} + e0) l_p$, where e_t is the enegy utilization while transmitting a message of l_p bits, d_r is the transmission range, e_1 is the loss coefficient per bit, α is the way loss exponent type and e_0 is the over the top energy expended on detecting, coding, adjustments, etc. For MIMO transferring between cluster heads and SenCar, we use the outcomes for 2×2 MIMO. At the point when dr =40 m, the energy utilization per bit is 0.6×10^{-5} J/bit. Every sensor holds 5,120 bytes detecting information. Every information message is 10 bytes and every control message is 1 byte (overhead). Along these lines, energy utilizations per information message for SISO and MIMO are 1.28 and 0.48mJ,

1. d_r = 40m, $e_0 = 45 \times 10^{-9}$ J/bit, $e_1 = 10 \times 10^{-9}$ J/bit, $\alpha = 2$. separately.

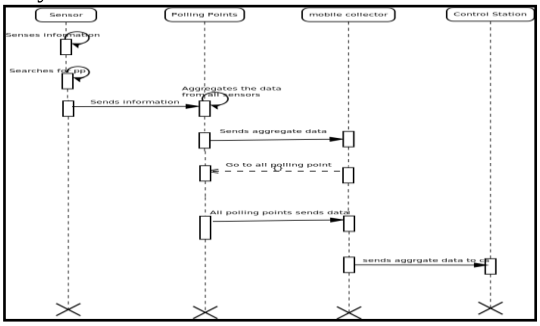


Fig.5.Data gathering in sequence

The code for this undertaking is composed in NS2 and the outcome is taken in the Network Animator (NAM) window. In the NAM window the arrangement of nodes, the Cluster Head for every group, correspondence of Cluster Head with the Mobile Collector lastly handover of information to the Control Station is appeared with the assistance of this yield.

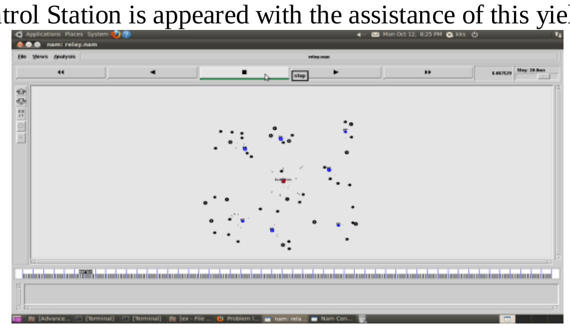


Fig.6. Topology for analysis

The topology for the analysis of energy efficiency and data gathering are shown in the figure 6. This topology will be having more number of sensors, theses sensors will be grouped into clusters. Each cluster will be allocated with cluster head, which collects all the information from other sensors within the cluster.

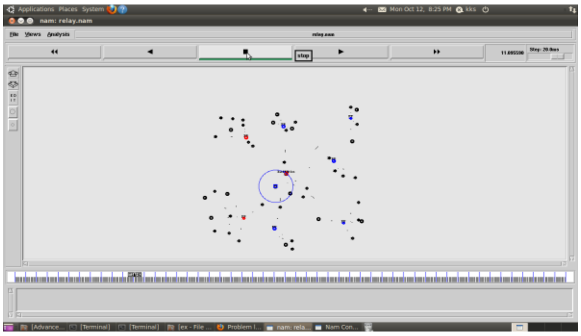


Fig.7. Arrival of SenCar.

Each cluster head will be having the Threshold value.Once these cluster head attains the threshold value it will be indicated in red color, this indicates the draining of energy of respective cluster head. Due to this the collected information is not transmitted to the Base Station (BS). Each BS waits for sometime once the time is out it signals the SenCar to reach the particular cluster head for collecting the gathered information as shown in figure 5.After this process the collected information will be given to BS by SenCar.

IV. CONCLUSION

In this paper we have used the Load Balance Clustering Technique for decreasing the energy consumption of each sensor in the network. Due to this the life time of the network can be increased. The network life time and data gathering speed can be further maximized by implemented by using two SenCars.

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