A Novel Approach for Reducing Energy Consumption Using K-Medoids in Clustering Based WSN

Pavithra M K[1], Poonam Ghuli[2]

[1]PG Student, Department of CSE RVCE Bangalore, India

[2]Assistant Professor, Department of CSE RVCE Bangalore. Inidia

Abstract: ***Enormous information has considered being promising application in the field of data and correspondence innovation (ICT). WSNs are utilized to assemble enormous information in correspondence innovation. In the vast majority of case the information from single sensor is insufficient useful to client. To assemble huge information, it is important to accumulate data from appropriated sensors. Due to constrained power in WSNs enormous information get-together is testing assignment. To expand system lifetime in WSNs the ways for information move are picked in such a route, to the point that the aggregate vitality devoured along the way is diminished. To backing enhanced information accumulation and high adaptability, sensor hubs are frequently gathered into non-covering, disjoint subsets called groups. Bunches make progressive WSNs which fuse effective use of restricted assets of sensor hubs and henceforth augments lifetime of system. In this paper we proposed a productive route for information social event utilizing bunching based strategy. Here we utilized k-medoids grouping procedure for the ideal number of groups and made sink hub direction, utilized as effective information gatherer.***

Keywords: WSN, Big Data, lifetime, Aggregation, overlapping, Clusters, k-medoids, trajectory

1. Introduction

Remote sensor systems (WSNs) have think of a powerful answer for a large number of the applications like military, medicinal services, home, and so forth late advances in remote interchanges and gadgets have empowered the improvement of minimal effort, low power and multi utilitarian sensor hubs. A remote sensor system comprises of a few number of sensor hubs that are appropriated thickly inside of a system territory. The position of sensor hubs are require not be foreordained or built. This permits arbitrary circulation in blocked off landscapes or calamity alleviation operations. Then again, this additionally implies that sensor system conventions and calculations must have self-sorting out abilities. Another remarkable element of sensor systems is the helpful exertion of sensor hubs. Sensor hubs are fitted with an installed processor. As opposed to sending the crude information to the hubs in charge of the combination, they utilize their preparing capacities to provincially do straightforward calculations and transmit just the obliged and incompletely prepared information. The portrayed elements guarantee an extensive variety of utilizations for sensor systems. A percentage of the application zones are wellbeing, military and home. In military, for instance, the quick organization, self-association, and adaptation to internal failure attributes of sensor systems make them exceptionally encouraging detecting procedures for military order, control, correspondences, registering, insight, reconnaissance, surveillance, and focusing on frameworks. Acknowledgment of these and other sensor system applications oblige remote specially appointed systems administration procedures. Conventions utilized as a part of remote impromptu systems were not appropriate the exceptional elements and application necessities of sensor systems. The real confinements of remote sensor arrange their restricted force stockpiling limits and inclined to disappointments. Consequently vitality productivity is the significant issue in sensor system.

As data innovation develops quickly, volume of the information additionally expanding at the same time. Getting to the recovering enormous information is essential for the client in numerous applications. Enormous information is a trendy expression, or catchphrase, used to depict a gigantic measure of both organized and unstructured information that is large to the point that its hard to process utilizing conventional database and programming methods. In most undertaking situations the information is too huge or it moves too quick or it surpasses current handling limit. Huge information can possibly help organizations enhance operations and make speedier, more clever choices. Gathering expansive sum information from sensor hubs is the real concern in the field of ICT. Singular sensor hubs may not give precise data. Hence gathering information from different sensor hubs is exceptionally key.

Keeping in mind the end goal to accumulate these information, the WSNs are built in such a way the sensors transfer their information to the "sink". Nonetheless, in the event of broadly and thickly appropriated WSNs there are two issues in assembling the information detected by a great many sensors. Initially, the system is isolated to some sub-systems due to the constrained remote correspondence range. Second, the remote transmission expends the vitality of the sensors. Despite the fact that the volume of information produced by an individual sensor is not huge, every sensor obliges a ton of vitality to transfer the information created by encompassing sensors. Particularly in thick WSNs, the life time of sensors will be short on the grounds that every sensor hub transfers a considerable measure of information created by enormous number of encompassing sensors. To take care of these issues, we require a vitality productive system to assemble enormous volume of information from countless in the thickly circulated WSNs.

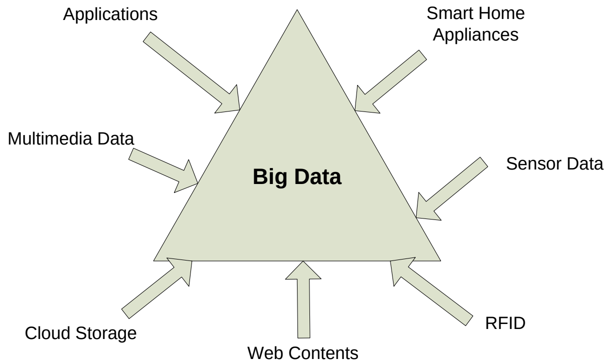


Figure 1: An Overview of Big data Gathering

To accomplish vitality effective information gathering in thickly appropriated WSNs, there have been numerous current methodologies. Grouping is a standout amongst the most broadly utilized methods to make WSNs vitality proficient. Low vitality versatile grouping progressive (LEACH) bunching calculation is acquainted with amplify the life time of remote sensor system. In [] utilized desire boost grouping system.

In this paper we proposed an enhanced technique to assembling vast information in thickly conveyed sensor system utilizing k-medoids grouping calculation. K-medoids calculation is utilized as bunching of WSNs. K-medoids is not just powerful in grouping additionally strong in selecting bunch heads in extensive WSNs. Later we presented a compelling sink hub directing for gathering information from every group heads.

2. Related Work

In late writing numerous methods have been proposed to accomplish productive information accumulation in WSNs to be specific LEACH (Low-Energy Adaptive Clustering Hierarchy), EM (Expectation Maximization). All these methodologies have attempted their level best for decrease vitality utilization and draw out system lifetime. Drain is a self-sorting out, versatile grouping convention. To have least vitality utilization, hubs in LEACH are assembled into various bunches in view of their battery use. Every bunch has a group head, which corresponds with each hub of that bunch. The sink totals information, transmitted by group heads, from different hubs. Since a group head loses vitality because of rehashed transmissions, the bunch head is re-chosen taking into account the leftover vitality, as an outcome it delays the system lifetime.

Coordinated Diffusion is information driven conventions ordinarily utilized as a part of remote sensor systems. It comprises of a few components: intrigues, inclinations, information messages and fortifications (positive and negative). To total information by utilizing Directed Diffusion, the sink hub telecasts an "Interest" message that comprises of a period to-live esteem, furthermore the locations of the source and destination hubs. The destination hub on getting the solicitation transmits suitable information message to the source having the detected information. On the off chance that the downstream hubs can't be come to by the "interest" message from the present source then the present destination turns into the source hub by changes its address, diminishes the time–to-live esteem and rebroadcasts the "Interest "message.

The EM calculation is an established grouping calculation, where hubs are dispersed by blend appropriation to locate the most extreme probability estimation of the peripheral probability by iteratively applying the E-step and M-step. The comparison to EM can be communicated as :

$$P(x) = \sum_{k=1}^{K} \left(\pi_k N(x|\mu_k, \Sigma_k) \right) \quad (1)$$

where K and π_k indicate the total number of clusters and the mixing coefficient of the kth cluster, respectively. $N(x|\mu,\Sigma)$ is defined as follows,

$$N\left(x|\mu,\Sigma\right) = \frac{1}{(2\pi)|\Sigma|^{\frac{1}{2}}} \exp\left\{-\frac{1}{2}(x-\mu)^T \Sigma^{-1} (x-\mu)\right\} (2)$$

where x is the position vectors of all nodes. Cluster parameters, μ_k and Σ_k , are the position vector of centroid of cluster k and 2×2 covariance matrix of the kth cluster, respectively. At the first step, EM algorithm calculates each node's value of degree of dependence that is referred to as responsibility. The responsibility shows how much a node depends on a cluster. The nth node's value of degree of dependence on kth cluster is given by following equation.

$$\gamma_{nk} = \frac{\pi_k N(x_n|\mu_k, \Sigma_k)}{\sum_{j=1}^{K} \pi_j N(x_n|\mu_j, \Sigma_j)} \quad (3)$$

Because of its definition, the responsibility takes values between 0 and 1. At the second step, the EM algorithm evaluates K weighted center of gravity of a 2-dimensional location vector of nodes. This evaluation uses the responsibility value as weight of nodes. At the third step, the locations of the cluster centroids are changed to the weighted centers of gravity evaluated in the second step. And EM algorithm evaluates the value of the log likelihood as shown below.

$$P = \ln p\left(X|\mu,\Sigma,\pi\right) = \sum_{n=1}^{N} \ln\left\{\sum_{k=1}^{K} \pi_k N\left(x_n|\mu_k, \Sigma k\right)\right\} (4)$$

Until the value of log likelihood converges, the EM algorithm repeats all steps. This value of log likelihood is tediously decreasing, and the EM algorithm always terminates. Because the EM algorithm repeatedly updates cluster centroids' position vector, μ_k, and nodes' responsibility to kth cluster, γn_k, the sum of square of distances of each node to cluster gradually decreases and finally becomes optimal.

3. Proposed Algorithm

In this paper we mainly focused on efficient big data gathering from heterogeneous wireless sensor networks. When deals with the heterogeneous sensor nodes, there will be a problem of data inaccuracy. To overcome all the problems, we implemented effective cluster based technique. Figure 2 dipicts the block diagram of proposed system. In network initialization we create a network terrain with specific area and finite number of sensor nodes. For cluster formation we used k-medoids clustering algorithm. K medoids forms clusters and gives cluster heads

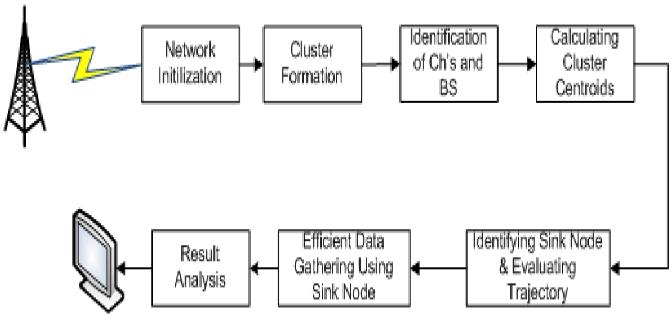


Figure 2: Block Diagram of Proposed System

3.1 K-medoids Clustering

Not the same as customary bunching calculations for remote sensor systems, in which bunch heads are chosen firstly and groups are shaped besides by letting non-head hubs associate with some head, the proposed grouping investigates the opposite system: firstly, the hubs are separated into particular bunches with the kmedoids grouping plan, and after that one hub inside every group will be chosen to be the head. Our system for building groups in dispersed manner performs over conventional LEACH-like calculations as far as activity parity and execution cost, accordingly prompting a more extended framework lifetime. We utilize the k-medoids calculation to gap the system hubs into k unmistakable bunches. Calculation 1 exhibits the stream of developing groups. The essential thought of the proposed bunching calculation lives in consistent cycles until an arrangement of heads is made sense of such that these heads circulate uniformly inside of the system region and all bunches are about the same in the quantity of part hubs.

3.2 Algorithm for K-medoids:

Require: the network graph $G(V, E)$; k, the number of clusters to be formed; λ, the fading factor of physical channel

Ensure: a set of clusters involving all nodes

Step 1: Select k nodes randomly as initial cluster heads, and use M to denote the set of those k cluster heads.

Step 2: Establish an empty set C_i for head h_i of M, and initialize C_i by $C_i \cup h_i$

Step 3: Establish a set N initialized empty

Step 4: while any node u of V/M do

Step 5: u chooses h_i of M as its head such that

$$\arg_{h_i} \min\{d^{\lambda}_{u,h_i} \mid \forall h_i \in M\}$$

where d_{u,h_i} is the Euclidean distance from u to h_i.

Step 6: $C_i \leftarrow C_i \cup u$

Step 7: end while

Step 8: while any C_i do

Step 9: Select a node u from C_i as new head such that

$$\arg_u \min\left\{\sum_{v=1, v\neq u}^{|C_i|} d^{\lambda}_{u,v} \mid \forall u \in C_i\right\}$$

Step 10: $N \leftarrow N \cup u$

Step 11: end while

Step 12: if $N \neq M$ then

Step 13: $M \leftarrow N$

Step 14: $N \leftarrow \emptyset$

Step 15: goto step 4

Step 16: end if

3.3 The trajectory of the mobile sink

After clustering of WSN nodes, we will determine the actual trajectory of the mobile sink. The mobile sink traverses through clusters and aggregates data from various nodes. Since it is possible to increase efficiency by reducing the travelling time, it is preferable that the mobile sink traces the shortest path among the cluster centroids.

3.4 Mobile Sink Data Collection

After arriving at the centroid, the mobile sink will broadcast data request message to nodes, which will in turn try to send the data collected to the mobile sink either directly or via other nodes in a multi-hop fashion.

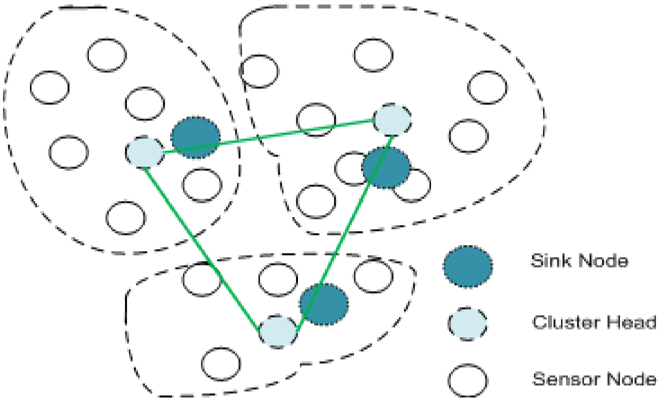
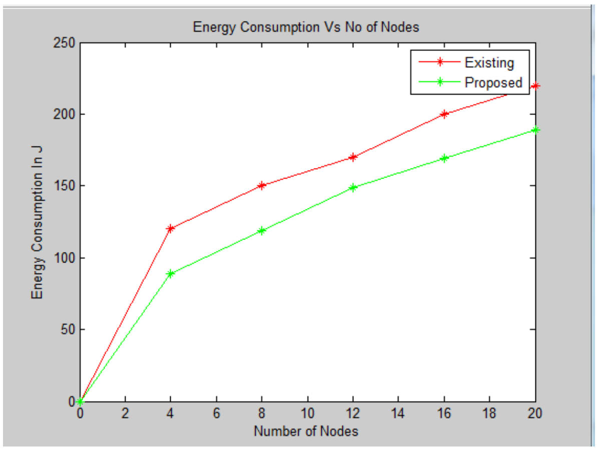


Figure 3: Data Gathering using Sink Node Trajectory

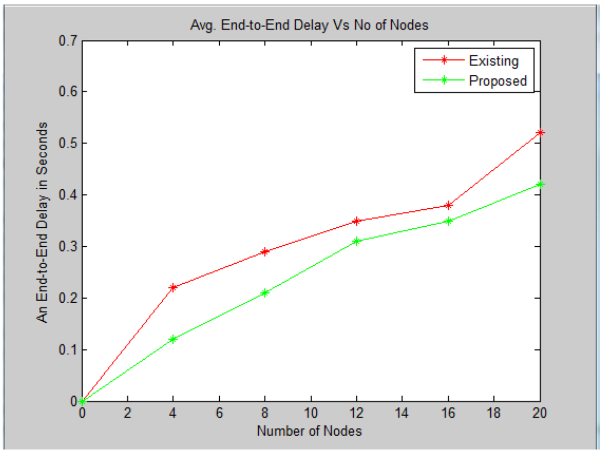
In addition to sending the collected data, the nodes will also rebroadcast the data request message to their Neighbouring nodes. And also main adjective of the sink node is to gather complete data with minimal trajectory, for minimizing energy consumption.

4. Performance Evaluation

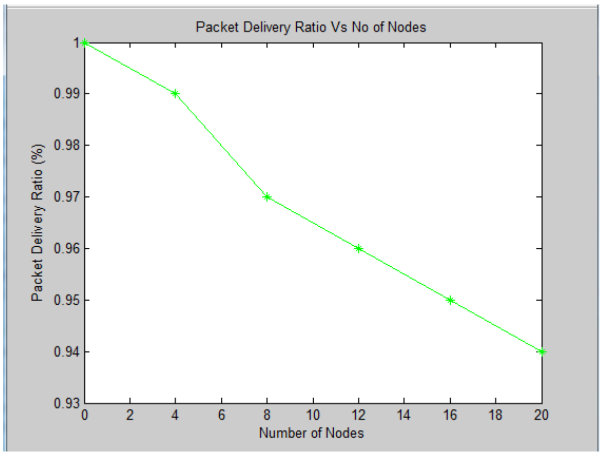
The proposed clustering algorithm is simulated by MATLAB. First we evaluated efficiency in energy consumption, second we evaluated reduced delay in data communication and finally we calculated packet delivery ratio. And also by using k-medoids algorithm optimal number of clusters are formed hence decreased in energy consumption which leads to increased network lifetime.



a. Energy Consumption of Sensor Nodes



b. Delay in Data Communication



c. Packet Delivery Ratio of Proposed method

5. Conclusion

In this paper we executed a vigorous calculation for huge information social event utilizing k-medoids calculation. K-medoids grouping is dependable bunching calculation in lessening force utilization for the most part for system with extensive number of sensor hubs. K-medoids is likewise viable calculation in selecting centroid. For lessening postponement furthermore enhance the execution of the system we utilized sink hub direction to assemble information. The outcomes demonstrate the adequacy of proposed framework. Our system is exceptionally vigorous in diminishing deferral, vitality utilization furthermore the execution of WNSs magnificently progressed.

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