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Energy Efficient Mobile Data Collection in Wireless Sensor Network

Neethu Krishnan[1], Abhitha.E[2]

PG Scholar, Dept of Electronics and Communication, MEA Engineering College, Perinthalmanna, Malappuram[1]

Asst. Professor, Dept of Electronics and Communication, MEA Engineering College, Perinthalmanna, Malappuram[2]

Abstract: Wireless Sensor Network (WSN) play a crucial role in today's world. The role of Wireless Sensor Network becomes effective if they can offer good sensing quality, network coverage, energy consumption mobility, long network lifetime, low data collection latency. A new data gathering mechanism for large scale Wireless sensor network is being introduced by deploying two cluster head within a cluster. Also a mobile collector, SenCar patrols the selected polling point for data collection and finally returns to static sink node where further data processing take place. The stimulation results demonstrate that proposed scheme of data gathering outperform the compared scheme.

Keywords: LBC, SenCar, cluster head, sensors

I. INTRODUCTION

Wireless Sensor Network has recently come into prominence because they hold nano technology and MEMS (micro electro mechanical systems) to design networks with tiny distributed sensors and actuators. Likewise, emerging technology in communication hardware, low power VLSI and embedded computing are combined together to make this technology appear as a reality, the union of computing and communications (ie., electronic technology and wireless communication) make potential to revolutionize in many segments of our life [6]. Since WSN has the ability to operate unattended, it becomes the first choice for the deployment in remote and hazardous environment. Resource limited sensor nodes are usually thrown into an unknown environment without a preconfigured infrastructure. Before monitoring the environment, sensor nodes must be able to discover nearby sensors and organize themselves into a network [4].

After that sensor nodes collect the required data and by any of the energy efficient technique, data is being gathered to the data processing center or the sink node and further analysis of the data takes place. In this case it is required an energy efficient and rapid data gathering technique. In the existing technologies, either a mobile collector will collect the data directly from the sensor nodes or by means of clustering technique, cluster head take the role of data collection else after the clustering, the mobile collector will collect the data from the cluster head. These approaches either balances any of the criteria of energy consumption, network lifetime, data latency etc but can't able to perform in a well utilize way so unsatisfactory data collection occurs. In this paper a new mobile data gathering technique is being proposed which alleviates the routing burden on nodes and thereby achieving minimized energy consumption and also balances the work load on the cluster heads.

II. PROPOSED APPROACH

The proposed scheme can be mainly be divided into three sections -clustering by LBC algorithm, inter cluster communication, data gathering to cluster head, trajectory planning.

A. Load Balanced Clustering

In order to cover a large area it is required a multi cluster head architecture, LBC self organize the sensors of the network into clusters and multiple cluster heads are chosen based on the residual energy. LBC can increase the system stability and also improves the node communication by balancing the load of the sensors during clustering.

B. Data gathering to cluster head

After clustering, the sensor nodes synchronize its clock with that of the cluster head (CH) and start the data gathering on time scheduled basis. Since each cluster having two cluster head and each of the nodes are within one hop distance from either of the two CH that data gathering takes place within a short time span.

C. Inter cluster communication

Cluster head information is passed to the SenCar before it starts it trajectory and this information is being used to optimize the trajectory path.

D. Trajectory planning

SenCar starts its patrolling by visiting the selected polling points. Upon reaching the polling points the cluster head group (CHG) starts uploading the data simultaneously to the SenCar by utilizing the Multi User- Multi Input Multi Output (MU-MIMO) technique. Optimum path to be visited is calculated by firefly algorithm.

In case of emergent data in any of the cluster for eg: fire, disaster etc the SenCar visits that particular cluster with earliest deadline.

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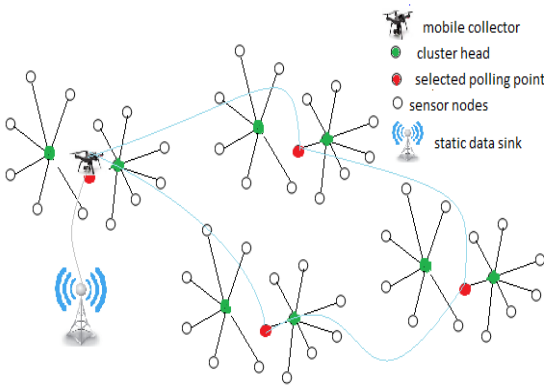

Fig 1. Architecture of proposed framework

Fig 1 shows the architecture of the proposed framework where shown the clusters, cluster head, polling point, mobile collector and static data sink.

Wireless Sensor Networks (WSNs) have emerged as a new information gathering paradigm for taking spatial and temporal measurements of a field. In such applications, sensors are usually randomly deployed over a field without a preconfigured infrastructure. Each sensor has the capabilities of monitoring the environment, collecting data and routing data back to a data sink. Typically, most energy of a sensor is consumed on two major tasks: sensing the field and uploading data to the data sink. Energy consumption on sensing is relatively stable since it only depends on the sampling rate. On the other hand, the energy consumption on data uploading is nonuniform among sensors. It strongly depends on the network topology and the location of the destined data sink. As a result, the energy of the sensors near the sink is depleted much sooner than others since these sensors need to relay much more packets from the sensors far away from the sink. Therefore, how to efficiently aggregate the information from scattered sensors, generally referred to as data gathering, is an important and challenging issue in WSNs as it largely determines network lifetime[1].

Load balancing algorithm (LBC) [3] clusters the sensors and each of the clusters having multiple cluster heads called cluster head group (CHG) which is elected based on the residual energy. After clustering, the cluster members synchronize their clock with the cluster head and starts data forwarding. The data is being passed to the CH on time scheduled basis.CHG information is being passed to the mobile collector (here 'SenCar') before it starts for the data collection tour.

Since the data has to be collected without time latency a polling point is being selected which is within the range of the two CH. When SenCar starts its trajectory, the trajectory path is selected by the firefly algorithm[7][8] which optimizes the path and on reaching each of the selected polling points dual data uploading takes place utilizing MU-MIMO technique. Likewise each of the clusters is being visited and finally all the collected datas are uploaded to the static data sink. If there is any emergent message to be reached the data processing center then that particular cluster is visited first.

III. PERFORMANCE APPRAISAL

The performance of the framework is being evaluated in this section. Simulation is conducted by using NS2 simulation tool. Since the main scope of the paper is data gathering using SenCar from multiple CH to achieve good scalability, low energy consumption, low data collection latency.

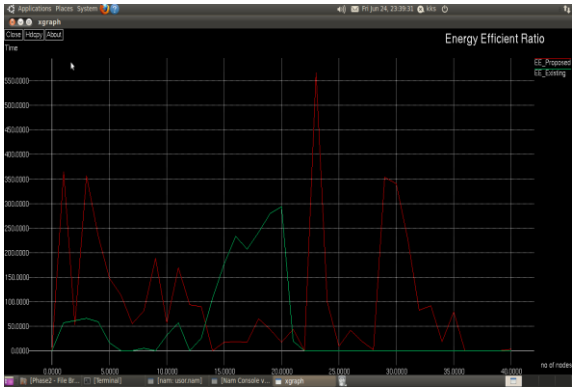

Fig 2. Graph of energy efficient ratio

Energy efficiency is one of the important parameter in WSN. From the graph it is clear that the proposed approach outperforms the existing system.

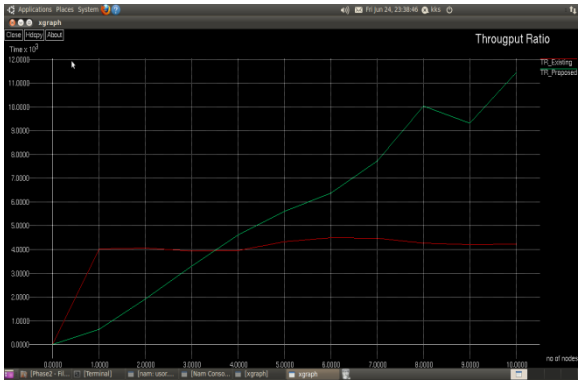

Fig 3. Graph of throughput

Since throughput is the average of the successful message delivery over a communication channel thre proposed scheme of dual data uploading utilizing MU-MIMO technique shows a great improvement compared to the existing system.

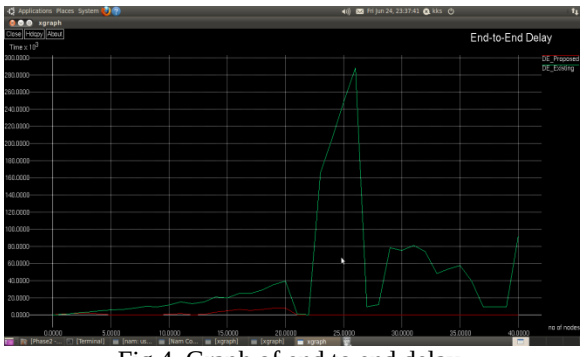

Fig 4. Graph of end to end delay

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End to end delivery of the data has to be minimised in WSN so that delay of the message in reaching the destination can be reduced. Proposed system greatly shorten the delay.

IV. CONCLUSION

In this paper, a new mobile data gathering in WSN is presented with load balanced clustering algorithm and dual data uploading. Simulation results shows that proposed scheme outperforms in all aspects ie., throughput, energy efficiency and end to end delay.

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