



## Energy Efficient Routing for Wireless Sensor Network through Event-Based Clustering Mechanism

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**Abstract**— *Sensor networks are collection of sensor nodes which co-operatively send sensed data to base station. As sensor nodes are battery driven, an efficient utilization of power is essential in order to use networks for long duration hence it is needed to reduce data traffic inside sensor networks, reduce amount of data that need to send to base station. As sensor nodes sense the data, process it, and send it to the base station, there are wide chances that the data generated from the neighboring sensors is often redundant and correlated. The unavoidable issue is that in large sensor networks, the amount of data generated is enormous for the base station to process. There is severe need of the methods for combining data into high quality information at sensors or intermediate nodes which can lead to the energy conservation by reducing the number of packets transmitted to base station. To achieve this, data aggregation approach has been explored and an in-network data aggregation strategy has been proposed that is showing better results in term of energy consumption.*

**Keywords**— *Routing Protocol, in-Network Aggregation, Wireless Sensor Networks. QoS, Clustering.*

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### I. INTRODUCTION

In few years, there have been noticeable advancements in the technology mostly involved in producing Micro-Electro Mechanical Systems (MEMS), digital electronics, and wireless communications. This has brought a revolutionary change by the development of minimal effort, low-force, multi-purpose little sensor nodes that can communicate over short distances. Recently wireless networks are gaining prominence due to its versatility, simplicity and extremely moderate and cost sparing establishment. WSN embodies small light weighted wireless nodes referred to as sensor nodes, which are deployed in large numbers in physical or environmental condition, and are collaborated to form an ad hoc network capable of reporting to base station. These nodes measure the physical parameters for instance sound, pressure, temperature, and humidity. Wireless sensor network serve various applications like health monitoring, habitat monitoring, military survival lance, building monitoring and target tracking. Wireless sensor network has many advantages and uses but still it realized as resource constraint in case of energy, memory, computation and limited communication capabilities [1].

The energy consumption of the sensor nodes occurs during the communication between the nodes, the environment sensing and the data processing. Subsequently, most of the WSN routing protocols aims mainly at the fulfillment of power conservation. Since most of the routing protocols are executed for wired networks hold the objective of high Quality of Service (QoS), they are practically improper for application in WSNs. For these reasons, many protocols have been proposed for data routing in sensor networks [2].

In the light of prerequisite of unattended operation in remote or possibly threatening areas, sensor systems are amazingly energy-limited. However since different sensor nodes often detect regular phenomena, there is prone to be some redundancy in the information, the different sources impart to a specific sink. In-network filtering and processing techniques can definitely help to conserve the scarce energy resources [3]. Energy consideration is an important aspect in throughout the creation of network topology; the energy considerations affect the process of setting up routes in WSN. Since the power depletion of a wireless link is proportional to square or even higher order of the distance between the sender and the receiver, multi-hop routing is assumed to use less energy than direct communication. In any case, multi-hop routing reduces network overhead to maintain the network topology and medium access control. A straight forward method to collect the data about the sensed parameters by the sensor nodes from the network is to allow each sensor node's to forward their sensed data to the base station, possibly via other intermediate nodes, before the base station processes the received data. However, this method of sending data by each node to the sink is prohibitively expensive in terms of communication overhead, which prompted active research to design an energy-efficient mechanism. But in most cases, sensor nodes are randomly scattered so multi-hop routing is unquestionably defector [4].

Subsequently, with a specific end goal to diminish the power consumption of wireless sensor networks, several mechanisms are proposed such as radio scheduling, control packet elimination, topology control, and most importantly data aggregation. Numerous examination studies have demonstrated that the hierarchical network routing and the clustering mechanisms make significant improvement in WSNs in reducing energy consumption and overhead. Clustering protocols can reduce communication overhead and improve network lifetime since they do not have to manage the location information of sensor nodes. As a result, clustering allows nodes saving more energy leading to a longer network life time.

## **II. DATA AGGREGATION**

Sensor nodes are densely deployed in wireless sensor network that means physical environment might produce much alike data in close by sensor node and transmitting such type of data is more or less redundant. So all these truths empower utilizing an aggregation of sensor nodes such that clusters of sensor nodes might be joined together or clamp information together and transmit just compact information. This can reduce traffic in individual cluster and also reduce global data that send to the sink. In typical wireless sensor networks, sensor nodes are usually have limited resources and battery. In order to save resources and energy, data must be aggregated so as to avoid overwhelming amounts of traffic in the network. There has been extensive work on data aggregation schemes in sensor networks. The aim of data aggregation is to eliminate redundant data transmission and enhances the network lifetime by conserving energy in wireless sensor network [1].

A significant energy saving mechanism for sensor nodes is to endeavour in-network data aggregation. The raw sensed data is typically forwarded to a sink node in wireless sensor networks for processing. The primary thought of in-network data aggregation is to wipe out unnecessary packet transmission by filtering out redundant sensor data and/or by performing an incremental evaluation of the semantic of the data.

Mostly, a large number of sensor nodes in a typical wireless sensor network gather application oriented information from the environment and transfer this information to a central base station where it is processed, analysed, and used by the application. Wireless sensor network is a resource constrained network; the general approach followed is to mutually handle the data created by different sensor nodes before being forwarded toward the base station. Such distributed in-network processing of data is generally known as data. The primary objective of data aggregation is to expand the network lifetime by reducing the resource consumption of sensor nodes. The design of an efficient data aggregation protocol is an inseparably challenging task in light of the fact that the protocol designer must trade-off between data accuracy, latency, energy efficiency, fault-tolerance, and security. Data aggregation techniques are tightly coupled with how packets are routed through the network. The architecture of the wireless sensor network is presuming as a crucial part in the performance of different data aggregation protocols. There are many protocols that allow routing and aggregation of data packets simultaneously [5].

It is critical to develop energy-efficient data-aggregation algorithms so that network lifetime is enhanced. There are several factors which affect the energy efficiency of a sensor network, such as network architecture, data aggregation mechanism, and the underlying routing protocol. Data aggregation reduces energy consumption by combining data from different nodes to suppress redundancy and traffic volume.

## **III. DATA AGGREGATION TYPES**

Data aggregation requires an ideal forwarding model, different from the classic routing, typically including the shortest path by some specific metric to forward data toward the base station. Unlike the classic routing approach, in data aggregation routing algorithms, the packets are routed based on their content and the nodes choose the immediate next hop that maximizes the overlap of routes in order to promote in network data aggregation. These protocols can be categorized into two parts: tree-based data aggregation protocols and cluster-based data aggregation protocols.

### **A. Tree- Based Approach:**

In the tree-based approach, aggregation is done by constructing an aggregation tree, which could be a minimum spanning tree. In which sink is consider as root and source nodes are considered as leaves. Each children node has a parent node to forward its sensed data. Data flow starts from leaves nodes up to the sink and there data aggregation is done by parent nodes.

### **B. Cluster- based Approach:**

In cluster-based approach, whole network is divided in to several clusters. Cluster is defined as group of sensor nodes. Each cluster has a cluster-head which is selected on the bases of high energy level among cluster members. The role of aggregator is done by the Cluster- heads which aggregate data received from cluster nodes locally and then transmit the result to observer (sink).

## **IV. HYBRID ENERGY EFFICIENT DISTRIBUTED PROTOCOL**

Data aggregation procedure is performed by particular directing convention. The point is to aggregate data to minimize the energy consumption. So sensor hubs ought to course parcels dependent upon the information parcel content and pick the following hop in order to promote in network aggregation. Routing protocols can also employ clustering. Clustering can be extremely effective in one-to-many, many-to-one, one-to-any, or one-to-all (broadcast) communication.

HEED (Hybrid Energy Efficient Distributed) protocol is the clustering protocol. It uses residual energy level as primary parameter and network topology, node ID and other features are only used as secondary parameters to break tie between candidate cluster heads, as a metric for the selection of cluster to achieve load balancing. In this all nodes are assumed to be homogenous i.e. all nodes are having same initial energy [6].

HEED has four primary objectives:

- (i) Prolonging network lifetime by distributing energy consumption.
- (ii) Terminating the clustering process within a constant number of iterations.
- (iii) Minimizing control.
- (iv) Producing well-distributed cluster heads.

## **V. Tree Based Approach**

The most straightforward approach to aggregate information spilling out of the sources to the sink node is to choose some unique nodes that fill in as accumulation points and characterize a favoured course to be emulated when sending information.

In these conventions, a tree structure is built first and afterward utilized later to either course the assembled information or react to inquiries sent by the sink node. Aggregation is performed throughout the routing when two or more information parcels land at the same node of the tree. This node then totals all accepted information with its own particular information and advances stand out parcel to its neighbour that is lower in the tree. Be that as it may, this methodology has a few disservices. In most cases, tree-based protocols build a traditional shortest path routing tree.

A spanning tree is a graph that spans all the nodes as vertices and contains no cycles. The tree is structured in the way that the node with the smallest identifier is chosen as the root. All other nodes are connecting to this selected root via the shortest-path route. The protocol requires each node to exchange configuration messages in a format that contains its own identifier, its selected root, and the distance (in hops) to this selected root. Each node updates its configuration message upon identifying a root with a smaller identifier or the shortest-path neighbour. Furthermore, the neighbour for which the shortest-path configuration message comes from is chosen as the parent of a node whenever it is detected.

## **VI. MOTIVATION**

Nowadays, WSNs, due to the numerous benefits, support an ever growing variety of applications, including agriculture, environment and habitat monitoring, traffic control, object tracking, fire detection, surveillance and reconnaissance, biomedical applications, home automation, inventory control, machine failure diagnosis and energy management. However, despite the advantages that the utilization of a WSN offers, their use is severely limited by the energy constraints posed by the sensors. High energy consumption of the sensor nodes occurs during the wireless communication between the nodes, sensing and the data processing consume less energy as compared to communication. Therefore, most of the routing protocols in WSNs aim mainly at the achievement of power conservation.

As described by Kamanashis Biswas et.al [17], the whole network is clustered which leads to a load. For instance, consider an example where nodes are deployed in a mountain area to check humidity level. The clustering will be done whenever the humidity level will increase or decrease exceptionally as compared to the threshold value. Instead of arranging the whole network into clusters, only needed area will be clustered which will lead to less energy consumption and will be energy efficient. This shows the data aggregation is important in clustering the network.

## **VII. PROPOSED SCHEME**

There have been done a large number of researches on data aggregation in past few years. Energy efficient data aggregation algorithm is inherently a challenging task. Data aggregation protocols aims at eliminating redundant data transmission and subsequently enhance the lifetime of energy in wireless sensor network. Various studies have compared different aggregation schemes to conclude that data aggregation and in-network processing are highly useful for enhanced networks throughput and energy savings. Different algorithms have been proposed by different specialists for performing aggregation over data obtained from sensor nodes.

A novel Data Routing for In-Network Aggregation has been proposed in the paper that includes some key aspects such as a reduced number of messages for setting up a routing tree, high aggregation rate, and maximized number of overlapping routes, reliable data aggregation and transmission. It is also a cluster based approach. The main goal of proposed algorithm is to build a routing tree with the shortest paths that connect all source nodes to the sink while maximizing data aggregation.

The main challenge in routing algorithms is to ensure the delivery of the sensed data even in the presence of nodes failures and interruptions in communications. These disappointments get much more discriminating when data conglomeration is performed along the routing paths since packets with aggregated data comprises of the information from various sources and, in case of a packet loss, a considerable amount of information will also be lost. In the context of WSN, data aggregation aware routing protocols ought to present some desirable characteristics including a reduced number of messages for setting up a routing tree, high aggregation rate, reliable data transmission and also maximized number of overlapping routes. In order to overcome these numerous challenges, a strategy has been proposed for In-Network Aggregation. The proposed method is expected to achieve the minimization of the energy consumption in the routing.

**VIII. SIMULATION RESULTS**

In this section, the proposed method has been simulated in NS2.35 and the simulation results are presented.

**A. Simulation Parameters**

Simulator	NS 2.35
No. of events	3
Simulation time	70 sec
No. of nodes	49
Topology	1000m* 1000m
Transmission range	250 m
Traffic	CBR
Packet Size	512
Initial energy	100 J
Antenna	Omni directional
Propagation model	Two ray ground

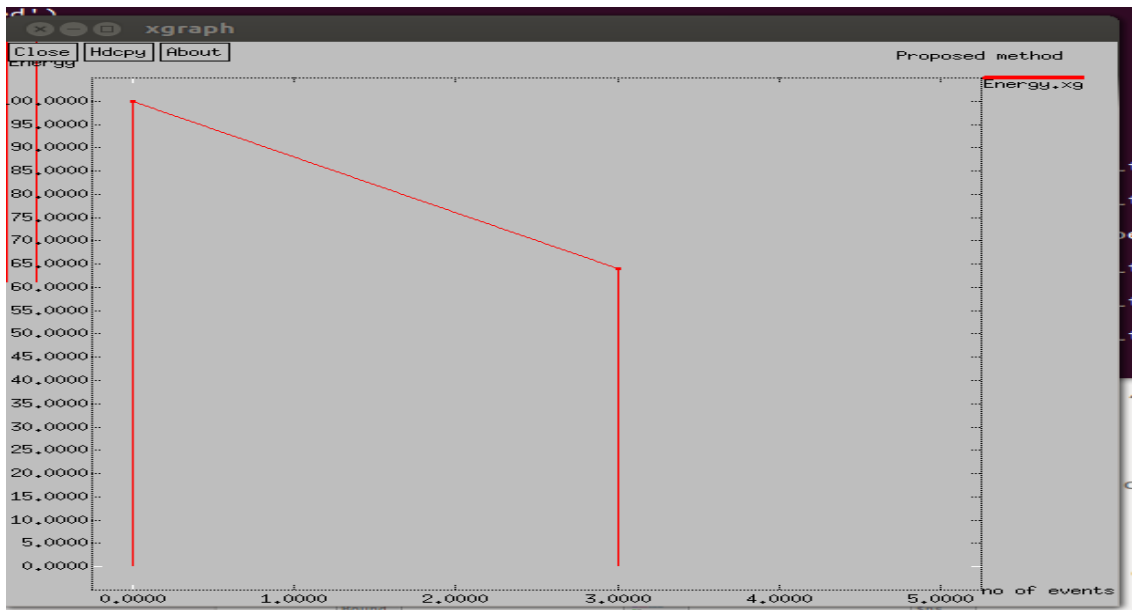


Fig. 1 Energy of proposed method

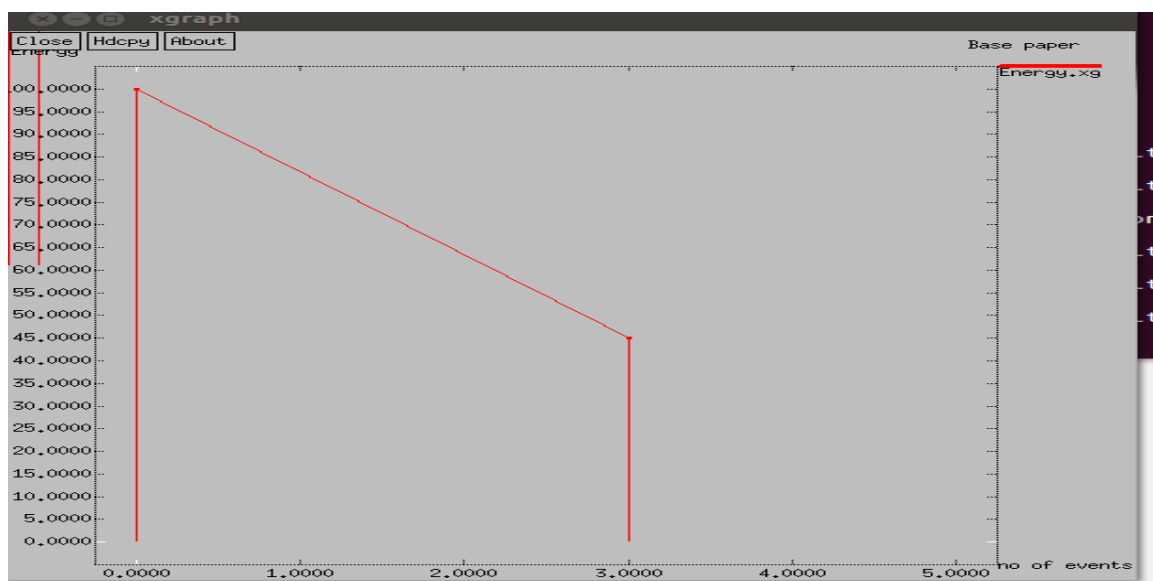


Fig. 2 Energy of existing system.

The energy wasted in broadcasting during leader advertisement is less in proposed method due to formation of limited number of clusters. While in base paper existing system, the energy wastage is more since the whole network is divided and clustered

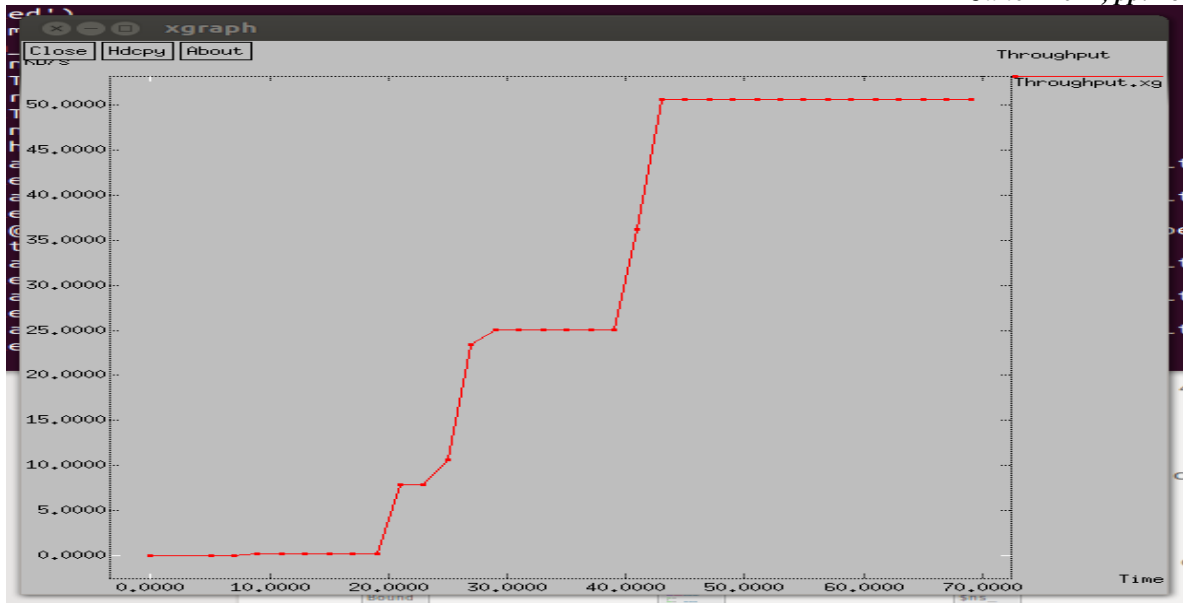


Fig. 3 Throughput in proposed method

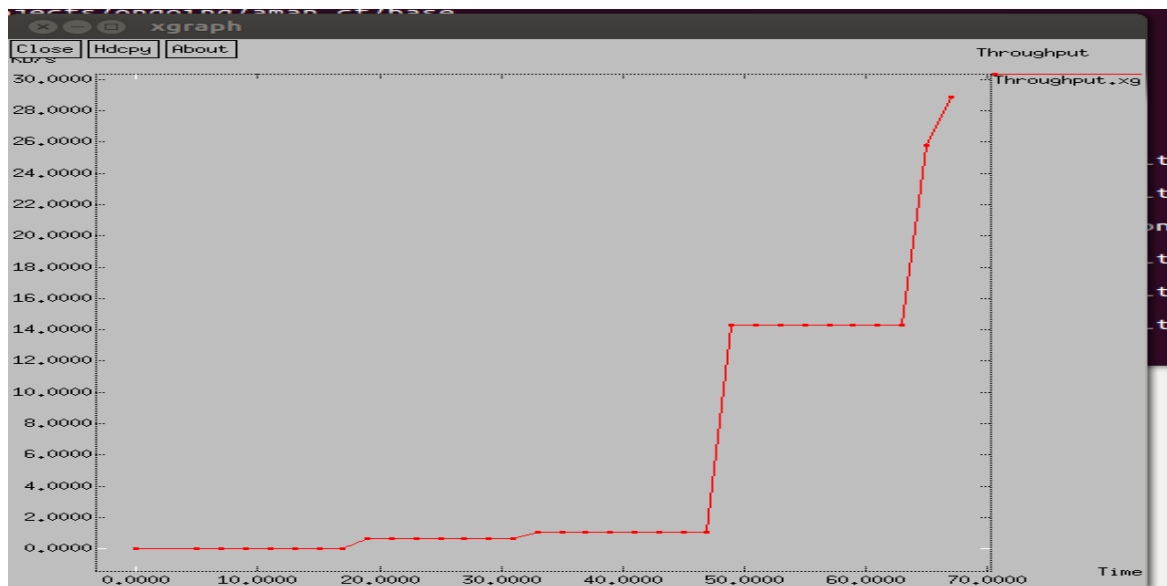


Fig. 4 Throughput in existing system

The proposed method is giving better throughput since the cluster formation is quicker as compared to division of whole network into clusters. As soon as the network is set up, quicker is data transfer.

### IX Conclusions

In this paper, a comprehensive overview of secure data aggregation concept in wireless sensor networks has been presented. The paper presents that wireless sensor network consists of huge number of sensor node having sensing, processing and communication capabilities. These nodes are resource constraint. That's why lifetime of the network is limited so the various approaches or protocol has been proposed for increasing the lifetime of the wireless sensor network.

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