Survey on data gathering techniques in wireless sensor network

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Abstract

The Wireless Sensor Networks (WSNs) applications have evolved exponentially over the last few years. There is one method used in WSNs to expand network lifetime and provide more efficient clustering working procedures. Clustering is a method of subdividing the sensor network sensing area into number of clusters. Growing cluster options for a leader called the cluster's head. The sensor node in the cluster or pre-assigned by the network builder may choose a cluster head. Optimized clustering will save a lot of energy for the network. Optimized clustering of networks would save a lot of money. WSN is the branch of external environment sensing information, where human contact is not possible. Different methods have been used in WSN for data sensing and network transmission.Different researches have been analyzed in this paper to extract useful knowledge for effective energy management and data transmission in WSN. This paper describes different approaches based on clusters, relay-based approaches and chain-based approaches. Relay based WSN uses a relay node to receive sensor node information which causes problems in large networks.Based on the study of these various methods, dynamic clustering approach provides efficient use of resources in WSN

Keywords: Network lifetime, cluster size, LEACH, PEGASIS, HEED, data gathering.

Introduction

Recent advances in the areas of Micro Electro Mechanical Systems (MEMS), wireless communication, and low-power designs have allowed sensor nodes powered by small battery sizes. A WSN is a series of sensor nodes which are deployed in a physical area and linked through wireless connections.A sensor node consists mainly of four modules, which are supply of sensing, communication, processing and power. The sensing circuitry tests the various environmental parameters, such as temperature, humidity, pressure etc., and transforms them into an electrical signal. The processing of these signals shows certain properties about the artifacts or events that occur in the sensor surroundings.When these signals are processed, they can be transmitted to destination (base station) either directly or through an intermediate gateway using the radio transmitter. A sensor network's basic features are self-organizing capacity, dynamic network topology, limited battery power, short range broadcast communication, mobility of nodes, routing and large deployment size.Sensor networks are expected to be used in civil, industrial, and military applications such as surveillance, environment and habitat monitoring, vehicle tracking, disaster management, medical observation, and acoustic data collection due to the capacity for self-organization and wireless communication[1]. Wireless sensor networks face multiple problems.Maximizing the reliability as well as network lifetime is the main challenge. Replacing the batteries from hundreds or thousands of sensor nodes after deployment is not feasible. The grouping of sensor nodes into a cluster in a sensor network is called clustering.Each cluster has a leader called the head of the cluster. A head of a cluster can be pre-assigned or elected by the cluster leaders. A cluster head gathers data from cluster nodes and is moved to destination (base station)[2]. The clustering techniques commonly perused by researchers improve both lifetime as well as goals of scalability.Many clustering protocols can be used when communicating with the base station to create hierarchical structure that reduces the cost of the path.

Wireless Sensor Network: A wireless sensor network is a group of specialized transducers with a communications system designed to track and record conditions at different locations.Temperature, humidity, density, wind direction and speed, light strength, vibration rate, sound strength, power-line voltage, chemical concentrations, levels of contaminants and critical body functions are generally monitored parameters.The more modern networks are bi-directional, and allow sensor activity control as well. Military applications such as battlefield surveillance inspired the creation of wireless sensor networks; today, these networks are used in many industrial and consumer applications, such as industrial process monitoring and control, computer health monitoring[3].

Parts of WSN:

Sensor Node Parts: It is a central component of WSN. This node plays multiple roles in WSN, such as basic sensing; storing data; routing; and processing data.

Clusters: The organizational structure for WSNs is the clusters. The complex existence of such networks demands that they be broken down into clusters in order to simplify these communication tasks[4].

Heads of clusters: Heads of clusters are the running head of the cluster. They're also required in the cluster to handle tasks. Such activities include but are not limited to data collection, and the coordination of a cluster's contact schedule.

Base Station: At the top level of the hierarchical WSN, the base station is. It provides the link between sensor network and end-user communication.

End User: The data can be used for a wide variety of applications within a sensor network. Therefore, the network data may be accessed by a single program over the internet, using a PDA or even a laptop.

Clustering

A free sense of Clustering may be "the arrangement of articles in meetings whose individuals are somehow comparable."A cluster is an aggregation of items along these lines that are "comparable" in the center of them and are "divergent" to the papers finding a position of different cluster.

Clustering is a separation of knowledge into comparable object sets. Talking to the knowledge by fewer clusters ultimately lacks several fine subtle elements, however accomplished it is entangled.The knowledge is represented by its clusters. Knowledge showing clustering places in a verifiable perspective defined in arithmetic, observations, and numerical analysis. From the point of view of machine learning groups as opposed to concealed instances, hunting down bunches is unsupervised learning and the subsequent structure speaks to an idea of knowledge.Clustering takes on a remarkable role in information mining applications from a convenient point of view, for example, logical knowledge investigation, data recovery what's more; content mining, space database applications, web analysis, CRM, displaying, therapeutic diagnostics, computational science, and many more[5].

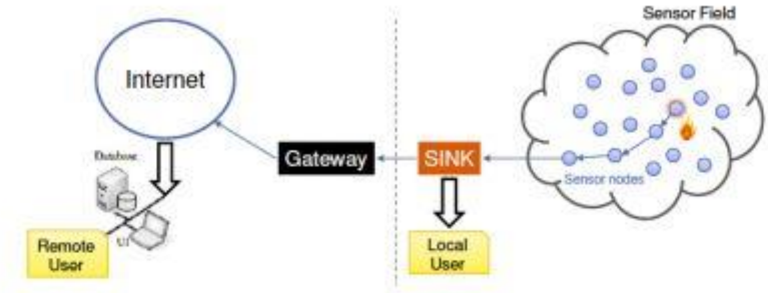

Fig. 1 Wireless Sensor Network[6]

Wireless Sensor Network Applications

Ecological Information Collection: Specific sensor information is collected as part of a timeline in natural knowledge collection applications. If a data to be relevant should remain at known locations to collect sensor data at regular intervals, and the nodes.A large number of nodes in the application for the collection of environmental data continuously senses and transmits data back to a set of base stations that store data using traditional methods.

Military Applications: Much of the important learning of sensor systems is necessary for the application of resistance to networks, in particular two crucial projects, the Distributed Sensor Networks (DSN) and the Defense Advanced Research Project Agency (DARPA), where sensor systems are effectively linked to military detection.Remote sensor systems currently can be an invaluable piece of military charge, control, exchange, registration, analysis, evaluation, monitoring and frame working.

Security Monitoring: The observing systems are gathered from hubs set in settled areas through a situation where one or more sensors are persistently screened to recognize an irregularity. A main difference between security screening and natural observation is that security systems do not really collect any information.This significantly impacts the design of the ideal system. Hub needs to check the status of its sensors as much as possible, but it only needs to send an information report when there is an infringement of security. The basic requirement of the system is the quick and solid communication of warning messages.These are systems called "Report by Exemption." Every hub is confirmed to be still present and running.

Hub: In which remote sensor system a named article follows across a space territory observed by a sensor system. There are various situations where one may want to monitor the critical resource or personnel area.Current stock management systems aim to monitor objects by documenting the last checkpoint an item has passed. Nonetheless, it is impossible to agree on the present field of an article with these structures. For example, UPS monitors through shipment by inspecting it at whatever point it passes through steering focuses with a standardized identifier.The system divides when things don't spill out to checkpoint. It is illogical to expect that demonstrations would regularly go through checkpoints in ordinary workplaces.

Wellbeing Software Sensor systems: They are also used as part of the social security field in general. In some present-day healing facility sensor systems are built to screen physiological information understanding, to track and screen patients and specialists in the medication organization, and inside a doctor's facility.Some clinic in Taiwan also used RFID fundamental of the above-mentioned applications in spring 2004 to guide the situation. Long haul nursing home this program focuses on treating the elderly.

Clustering Algorithms and Wireless Sensor Network Protocols

Low Energy Adaptive Cluster (LEACH) Hierarchical Protocol

In LEACH the current Cluster Head (CH) energy level is tested after every round and if its energy is drained and below the threshold value then new CH will be selected based on the probabilistic principle[6].CH's roles are to be rotated or shared among the network's sensor nodes. The CH obligation distribution stabilizes the energy consumption of network nodes, so that no node is overwhelmed.

Hybrid energy efficient distributed computing protocol (HEED)

To increase the energy consumption balance between different parts of the sensor network, remaining or residual energy, node degree or node density have been used as the main parameter for CH selection.The HEED protocol operates on the three key parameters i.e. distribution of energy usage to increase the lifespan of the network, selection of CH is to be terminated after a fixed or predefined number of iterations and thirdly the CH is distributed or placed in such a way that the maximum number of nodes has an simple access to them.

PEGASIS

One such hierarchical routing protocol, which follows a chain-based approach and a greedy algorithm, is PEGASIS Power Efficient Gathering in Sensor information systems. The nodes of the sensors arrange themselves to form a chain.If any node dies in between then the chain is reconstructed to bypass the dead node. A leader or a cluster head node is assigned and it takes care of transmitting data to the base station/ sink node. The main goal of PEGASIS is to receive and transmit data to and from the neighbour and take turns being the cluster head for transmission to the Sink Node.

Cluster Based Routing Protocols Comparison

Clustering Approach	Clustering Method	Location Awareness	Heterogeneity Level	Cluster head Mobility	Connectivity Of CH to BS	Intra Cluster Topology	Cluster Count	Pure Probability	Neighbours
LEACH	distributed	No	-	Fixed	Direct Link	Single Hop	Variable	Yes	-
SEP	distributed	No	Two	Fixed	Direct Link	Single Hop	Variable	-	-
HEED	distributed	No	-	Fixed	Direct Link	Single Hop	Variable	Yes	-
DWEHC	distributed	No	-	Fixed	Direct Link	Single Hop	Variable	-	-
DEEC	distributed	No	Two/Multi	Fixed	Direct Link	Single Hop	Variable	-	-
DEBC	distributed	No	-	Fixed	Direct Link	Single Hop	Variable	-	-
UCR	distributed	Yes	Multi	Fixed	Multi Hop	Single Hop	Variable	Yes	-

C4SD	distributed	No	-	Mobile	Direct Link	Multi Hop	Variable	-	-
I-LEACH	distributed	No	-	Fixed	Direct Link	Single Hop	Variable	Yes	-
EEHC	distributed	No	Three	Fixed	Direct Link	Single Hop	Variable	-	-
SDEEC	distributed	No	Two	Fixed	Direct Link	Single Hop	Variable	-	-
SBDEEC	distributed	No	Two	Fixed	Direct Link	Single Hop	Variable	-	-
DCHE	distributed	No	Three	Fixed	Direct Link	Single Hop	Variable	-	-
EECS	distributed	No	-	Fixed	Direct Link	Single Hop	Variable	-	-
I-B-LEACH	distributed	No	-	Fixed	Direct Link	Single Hop	Variable	Yes	-
MNCP	distributed	No	-	Mobile	Direct Link	Single Hop	Variable	-	-
ECLCM	distributed	No	-	Fixed	Multi Hop	Multi Hop	Variable	yes	-
WEP	distributed	No	Two	Fixed	Direct Link	Single Hop	Variable	-	-
ECBDA	Hybrid	No	-	Fixed	Multi Hop	Single Hop	Variable	-	-
DCEBC	distributed	No	Two	Fixed	Single Hop	Single Hop	Variable	-	**Yes**
HSR	distributed	Yes	Two/Multi	Fixed	Multi Hop	Multi Hop	Variable	-	-
TBC	distributed	Yes	-	Fixed	Multi Hop	Multi Hop	Variable	-	Yes

PRODUCE	distributed	Yes	-	Fixed	Direct Link	Single Hop	Variable	-	-
EDBC	distributed	Yes	-	Fixed	Direct Link	Single Hop	Variable	-	-
DCLB	Centralized	Yes	-	Fixed	Multi Hop	Single Hop	Variable	-	Yes
DDCHS	distributed	Yes	-	Fixed	Direct Link	Single Hop	Variable	-	Yes
FEED	distributed	No	-	Fixed	Direct Link	Single Hop	Variable	-	Yes
EECSIA	distributed	No	-	Fixed	Direct Link	Single Hop	Variable	-	Yes

LITERATURE REVIEW

ShahulHameed A(2018): The conventional geographical routing and cross layer routing are discussed in this paper. Cross layer routing protocols are seen to be more energy efficient and robust compared to conventional protocols used in Wireless Sensor Networks (WSN).The routing protocol used in wireless sensor networks should be energy efficient and the message should be transmitted from source to sink without any packet loss. This paper discusses current protocols used in WSN's and describes the research weaknesses in the protocols for routing.

Zahra et. al(2017) Proposed a cross-layer routing system called Geographic Cross-Layer Routing adapted for WSN disaster relief operations (GCRAD) that overcomes the aforementioned problems by simultaneously affecting all relay node selection criteria. We implemented a new criterion for the selection of relay nodes, called possible relay number (PRN).This approach takes into account QPI and GPI averages for the process of selecting relay nodes. This protocol showed significant performance against existing cross-layer protocols such as ALBA-R, IRIS, etc.

Heimfarth et al. (2015) Suggested a joint MAC and routing layer method called AGA-MAC in which the source node searches for the receiver and selects the node that has the minimum sink distance as the relay node.

Petrioli et al. (2014) Proposed a cross-layer routing system called ALBA-R that integrates MAC, routing, and relay node selection schedule for sleep / awake. The Queue Priority Index (QPI) and the Geographic Priority Index (GPI) are significant variables considered for relay selection in this process by the International Journal of Pure and Applied Mathematics Special Issue 345. Taking QPI and GPI into consideration for relay selection decreased congestion by balancing traffic between various nodes.

Deganet. Al (2014)suggested an energy balanced routing system called FAF-EBRM in which the next hop is calculated on the basis of the capacity of the connection and the energy density forward. The experimental results show this protocol balances energy consumption and maintains high WSN QoS.

Zhao et al. (2013) Proposed a cross-layer routing system called Topology and Link Quality-Conscious Geographic Routing (TLG), incorporating physical and routing layer features. As relay node selection parameters, the function includes distance, energy, and quality of the link.

Wenget. al(2013) An energy-efficient routing algorithm called RIDSR (Relative Identification and Guidance for Wireless Sensor Networks) has been proposed which divides the sensing region into sectors. Each sector is a manager node that transmits the data to the base station. The Base Station offers unique ID in this protocol to all the International Journal of Pure and Applied Mathematics Special Issue 344, the nodes present in a sector centered on the name of the quadrant and the distance from the base station. The simulation results showed that this protocol substantially improved the energy consumption and the throughput.

Vuran et al. (2010) Proposed a new cross-layer routing, called XLP, which uses recipient-based contention and considers possible relay thresholds to ensure efficient communication. A four conditional function is used in this approach to evaluate the nodes that participate in the selection process for the relay node**.**The nearest node is chosen as the relay node with respect to the sink. In previously proposed approaches, status of queue nodes is not considered. This results in congestion and a drop in packets. Due to ignorance of important parameters ineffective transmission occurs in the methods described above.

Adel et al. (2010)suggested an energy-efficient data transmission protocol called the Energy Aware Geographic Routing Protocol (EAGRP) which would be more suitable for wireless multi-hop sensor networks. This protocol is based on the two parameters left in the nodes: position and energy. EAGRP's efficiency was substantially better compared to protocols previously in use.

Haibo et al. (2010) Proposed a routing scheme called Energy-Efficient Beaconless Geographic Routing in which the source node determines the area of relay search by calculating the point as the optimum position for relays. Through a handshake mechanism the closest node to the optimal point is chosen as the relay node.

PROBLEM STATEMENT

The aim of my research work is to study the concept of data gathering in the wireless sensor network. The focus of our work lies on making the process of data gathering to be efficient. We are using PEGASIS, genetic algorithm and ACO (ant colony optimization) techniques for data gathering. And compare these algorithms and find out which one is best for data gathering.

OBJECTIVES

(1) Understanding various artificial intelligence techniques

(2) Implementation of PEGASIS

(3) Implémentation of GENETIC algorithm

(4) Implémentation of ANT COLONY OPTIMIZATION algorithm

(5) Comparison of these algorithms on the parameters like energy consumption, end to end delay, packet drop etc. in the wireless sensor network.

METHODOLOGY

(1) Firstly we implement pegasis by following given steps:

a) Initialize the network parameters. Determine the number of nodes, initial energy, BS location information et al. Then chain construction starts.

b) BS broadcasts the whole network a hello message to obtain basic network information such as ID of nodes alive and distance from each node to BS.

c) Set the node which is farthest from BS as end node, it joins the chain first and is labeled as node 1.

d) End node of the chain obtains the information of distance between itself and other nodes which have not joined the chain yet, finds the nearest node and sets it as node I waiting to join the chain, i represents the i-th node joined.

(2) Implementation of pegasis using genetic algorithm by following given steps.

Step 1: firstly the numbers of relay nodes are calculated.
Step 2: now M sets of 2*(n + 1) chromosomes are generated. Where M is the population size and n is the number of relay nodes.
Step 3: now odd chromosomes of each set is used as x coordinate location of the relay nodes and sink node and even chromosomes is used as y coordinate locations for same.
Step 4: Ones the locations of all relay nodes and sink node is calculated the life time and transmission cost of each relay nodes and normal nodes are calculated.
Step 5: Calculate the fitness value for each of M sets of chromosomes.
Step 6: Select the chromosomes with best fitness value and perform crossover to get the new generations and delete the others.
Step 7: repeat steps 3 to 7 till the maximum generations completed or the goal is found.

(3) Implementation of pegasis using ANT COLONY OPTIMIZATION

(1) A number m of ants is positioned in parallel on m cities.
(2) The ants' start state, that is, the start city, can be chosen randomly, and the memory Mk of each ant k is initialized by adding the current start city to the set of already visited cities.
(3) Each ant is a simple agent.
(4) It chooses the town to go to with a probability that is a function of the town distance and of the amount of trail present on the connecting edge.
(5) Tabu list disallow the transition to already visited cities.

CONCLUSION AND FUTURE WORK

Clustering is the most common form of topology control to minimize energy consumption and increase the WSN scalability. Owing to the irreplaceable and minimal power sources of the sensor nodes, energy is the key restriction of wireless sensor networks (WSNs).Cluster heads (CHs) consume more resources in cluster-based WSN because of additional workloads due to data processing, data aggregation and connectivity to the base station. Therefore, effective cluster design is very difficult, given the CHs ' energy consumption.Various approaches to the development of an efficient clustering in WSN have been used to reduce energy consumption. During data transmission the average amount of energy consumed in WSN is.To overcome this problem, an approach that can sense changes occurred in the current sensed value and previous sensed value must be established to block redundant information.

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