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Energy Efficient Routing In Sensor Network Through Clustering

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Abstract:*In recent years, Data Gathering plays an important role in wireless sensor network. The data can be gathered using two methods. First, Static Sink can be used to collect data from sensors and routed to mobile station via multi hop communication. This increases the delay and consumes high energy. To reduce the consumption of energy, An cluster Algorithm With Energy Efficient Technique, is proposed. In this method, the multiple tinybee are dispatched from the mobile element and comes back to the mobile element with aggregated data. Thus it reduces the tour length of the mobile element and energy can be efficiently utilized. In this paper, we will be proposing an energy efficient technique that can be used to find out shortest path from a source node to the destination node using cluster algorithm. Cluster collects the data and then sends to base station. This proposed method achieves the energy efficient.*

Keywords: *Networks,Mobile element,cluster algorithm, tinybee, energy efficient,wireless sensor network.*

I. Introduction

A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to *monitor* physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling *control* of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding.

1.1Applications

a)Area monitoring: Area monitoring is a common application of WSNs. In area monitoring, the WSN is deployed over a region where some phenomenon is to be monitored. A military example is the use of sensors detect enemy intrusion; a civilian example is the geo-fencing of gas or oil pipelines.

b)Environmental/Earth monitoring: The term Environmental Sensor Networks has evolved to cover many applications of WSNs to earth science research. This includes sensing volcanoes, oceans, glaciers, forests, etc. Some of the major areas are listed below.

c)Air quality monitoring: The degree of pollution in the air has to be measured frequently in order to safeguard people and the environment from any kind of damages due to air pollution. In dangerous surroundings, real time monitoring of harmful gases is an important process because the weather can change rapidly changing key quality parameters.

d)Air pollution monitoring: Wireless sensor networks have been deployed in several cities (Stockholm, London and Brisbane) to monitor the concentration of dangerous gases for citizens. These can take advantage of the ad hoc wireless links rather than wired installations, which also make them more mobile for testing readings in different areas. There are various architectures that can be used for such applications as well as different kinds of data analysis and data mining that can be conducted.

e)Forest fire detection:A network of Sensor Nodes can be installed in a forest to detect when a fire has started. The nodes can be equipped with sensors to measure temperature, humidity and gases which are produced by fire in the trees or vegetation. The early detection is crucial for a successful action of the firefighters; thanks to Wireless Sensor Networks, the fire brigade will be able to know when a fire is started and how it is spreading.

f)Landslide detection:A landslide detection system makes use of a wireless sensor network to detect the slight movements of soil and changes in various parameters that may occur before or during a landslide. Through the data gathered it may be possible to know the occurrence of landslides long before it actually happens.

g)Water quality monitoring: Water quality monitoring involves analyzing water properties in dams, rivers, lakes & oceans, as well as underground water reserves. The use of many wireless distributed sensors enables the creation of a more accurate map of the water status, and allows the permanent deployment of monitoring stations in locations of difficult access, without the need of manual data retrieval.

h)Natural disaster prevention: Wireless sensor networks can effectively act to prevent the consequences of natural disasters, like floods. Wireless nodes have successfully been deployed in rivers where changes of the water levels have to be monitored in real time.

1.2Industrial monitoring:

i)Machine health monitoring: Wireless sensor networks have been developed for machinery condition-based maintenance (CBM) as they offer significant cost savings and enable new functionality. In wired systems, the installation of enough sensors is often limited by the cost of wiring. Previously inaccessible locations, rotating machinery, hazardous or restricted areas, and mobile assets can now be reached with wireless sensors.

j)Data logging: Wireless sensor networks are also used for the collection of data for monitoring of environmental information; this can be as simple as the monitoring of the temperature in a fridge to the level of water in overflow tanks in nuclear power plants. The statistical information can then be used to show how systems have been working. The advantage of WSNs over conventional loggers is the "live" data feed that is possible.

k)Industrial sense and control applications: In recent research a vast number of wireless sensor network communication protocols have been developed. While previous research was primarily focused on power awareness, more recent research have begun to consider a wider range of aspects, such as wireless link reliability, real-time capabilities, or quality-of-service. These new aspects are considered as an enabler for future applications in industrial and related wireless sense and control applications, and partially replacing or enhancing conventional wire-based networks by WSN techniques.

l)Water/Waste water monitoring: Monitoring the quality and level of water includes many activities such as checking the quality of underground or surface water and ensuring a country's water infrastructure for the benefit of both human and animal. The area of water quality monitoring utilizes wireless sensor networks and many manufacturers have launched fresh and advanced applications for the purpose.

m)Observation of water quality:The whole process includes examining water properties in rivers, dams, oceans, lakes and also in underground water resources. Wireless distributed sensors let users to make a precise map of the water condition as well as making permanent distribution of observing stations in areas of difficult access with no manual data recovery.

n)Water distribution network management: Manufacturers of water distribution network sensors concentrate on observing the water management structures such as valve and pipes and also making remote access to water meter readings.

o)Preventing natural disaster:The consequences of natural perils like floods can be effectively prevented with wireless sensor networks. Wireless nodes are distributed in rivers so that changes of the water level can be effectively monitored.

p)Agriculture: Using wireless sensor networks within the agricultural industry is increasingly common; using a wireless network frees the farmer from the maintenance of wiring in a difficult environment. Gravity feed water systems can be monitored using pressure transmitters to monitor water tank levels, pumps can be controlled using wireless I/O devices and water use can be measured and wirelessly transmitted back to a central control center for billing. Irrigation automation enables more efficient water use and reduces waste.

q)Accurate agriculture: Wireless sensor networks let users to make precise monitoring of the crop at the time of its growth. Hence, farmers can immediately know the state of the item at all its stages which will ease the decision process regarding the time of harvest.

s)Irrigation management:When real time data is delivered, farmers are able to achieve intelligent irrigation. Data regarding the fields such as temperature level and soil moisture are delivered to farmers through wireless sensor networks. When each plant is joined with a personal irrigation system, farmers can pour the precise amount of water each plant needs and hence, reduce the cost and improve the quality of the end product. The networks can be employed to manage various actuators in the systems using no wired infrastructure.

t)Greenhouses:Wireless sensor networks are also used to control the temperature and humidity levels inside commercial greenhouses. When the temperature and humidity drops below specific levels, the greenhouse manager must be notified via e-mail or cell phone text message, or host systems can trigger misting systems, open vents, turn on fans, or control a wide variety of system responses.

Recent research in wireless sensor networks in agriculture industry give emphasis on its use in greenhouses, particularly for big exploitations with definite crops. Such microclimatic ambiances need to preserve accurate weather status at all times. Moreover, using multiple distributed sensors will better control the above process, in open surface as well as in the soil.

u)Passive localization and tracking: The application of WSN to the passive localization and tracking of non-cooperative targets (i.e., people not wearing any tag) has been proposed by exploiting the pervasive and low-cost nature of such technology and the properties of the wireless links which are established in a meshed WSN infrastructure.

v)Smart home monitoring: Monitoring the activities performed in a smart home is achieved using wireless sensors embedded within everyday objects forming a WSN. State changes to objects based on human manipulation are captured by the wireless sensors network enabling activity-support services.

1.3Characteristics

The main characteristics of a WSN include:

- Power consumption constrains for nodes using batteries or energy harvesting
- Ability to cope with node failures
- Mobility of nodes
- Communication failures
- Heterogeneity of nodes
- Scalability to large scale of deployment
- Ability to withstand harsh environmental conditions
- Ease of use.

II. Related Work

K.Ramanan and E.Baburaj[1]Recent developments in processor, memory and radio technology have enabled wireless sensor networks which are deployed to collect useful information from an area of interest. The sensed data must be gathered and transmitted to a base station where it is further processed for end-user queries. Since the network consists of low-cost nodes with limited battery power, power efficient methods must be employed for data gathering and aggregation in order to achieve long network lifetimes. In an environment where in a round of communication each of the sensor nodes has data to send to a base station, it is important to minimize the total energy consumed by the system in a round so that the system lifetime is maximized. With the use of data fusion and aggregation techniques, while minimizing the total energy per round, if power consumption per node can be balanced as well, a near optimal data gathering and routing scheme can be achieved in terms of network lifetime. Several application specific sensor network data gathering protocols have been proposed in research literatures. However, most of the proposed algorithms have been some attention to the related network lifetime and saving energy are two critical issues for wireless sensor networks. In this paper we have explored general network lifetime in wireless sensor networks and made an extensive study to categorize available data gathering techniques and analyze possible network lifetime on them.

Mario Di Francesco, Sajal K. Das, Giuseppe Anastasi[2]Wireless sensor networks (WSNs) have emerged as an effective solution for a wide range of applications. Most of the traditional WSN architectures consist of static nodes which are densely deployed over a sensing area. Recently, several WSN architectures based on mobile elements (MEs) have been proposed. Most of them exploit mobility to address the problem of data collection in WSNs. In this article we first define WSNs with MEs and provide a comprehensive taxonomy of their architectures, based on the role of the MEs. Then we present an overview of the data collection process in such a scenario, and identify the corresponding issues and challenges. On the basis of these issues, we provide an extensive survey of the related literature. Finally, we compare the underlying approaches and solutions, with hints to open problems and future research directions.

Feng Wang and Jiangchuan Liu**[3]**

Wireless sensor networks (WSNs) have been applied to many applications since emerging. Among them, one of the most important applications is Sensor Data Collections, where sensed data are collected at all or some of the sensor nodes and forwarded to a central base station for further processing. In this paper, we present a survey on recent advances in this research area. We first highlight the special features of sensor data collection in WSNs, by comparing with both wired sensor data collection network and other WSN applications. With these features in mind, we then discuss the issues and prior solutions on the utilizations of WSNs for sensor data collection. Based on different focuses of previous research works, we describe the basic taxonomy and propose to break down the networked wireless sensor data collection into three major stages, namely, the deployment stage, the control message dissemination stage and the data delivery stage. In each stage, we then discuss the issues and challenges, followed by a review and comparison of the previously proposed approaches and solutions, striving to identify the research and development trend behind them. In addition, we further discuss the correlations among the three stages and outline possible directions for the future research of the networked wireless sensor data collection.

Ramesh Rajagopalan and Pramod K. Varshney [4]Wireless sensor networks consist of sensor nodes with sensing and communication capabilities. We focus on data-aggregation problems in energy constrained sensor networks. The main goal of data-aggregation algorithms is to gather and aggregate data in an energy efficient manner so that network lifetime is enhanced. In this article we present a survey of data-aggregation algorithms in wireless sensor networks. We compare and contrast different algorithms on the basis of performance measures such as lifetime, latency, and data accuracy. We conclude with possible future research directions.

Kaoru Ota, Mianxiong Dong[5]This paper proposes a mobile-agent-based data gathering system (called TinyBee) in wireless sensor networks. Most existing mobile-agent-based systems consider only static sinks/servers. In this paper, we consider both mobile servers and lightweight mobile agents. We aim to design a data gathering system using a special kind of mobile agent called TinyBee to collect data all over a network. TinyBee migrates from node to node after being dispatched from a mobile server in order to collect data so that physical movement of mobile servers is greatly reduced. Mobile-agent-based approaches outperform traditional client/server paradigms in terms of execution time and power consumption. Extensive simulation results demonstrate that our proposed schemes achieve significant performance gains.

III. Proposed Work

3.1Sensing coverage: Sensing coverage is defined as the ratio of the actual network coverage area to the desired area of coverage and it lies between 0 and 1. The sensing coverage depends on the density of the deployed sensor nodes. For a densely deployed sensor network the sensing coverage will be 100% for some initial time and based on the number of alive nodes its value eventually changes.

3.2Optimal clustering: Optimal clustering plays a key role in achieving energy efficiency of a sensor network. Having a more number of clusters while keeping equal processing load on each CH, will increase the overall communication overhead. As a result, the overall energy consumption gets increased. In contrast, if the number of cluster is less, then it will result in a large size of each cluster. In a large sized cluster, the farther nodes need more energy to transmit data to its respective CH. Therefore, cluster size cannot be too big or too small, an optimal cluster size needs to be chosen. Eventually, there will be an optimal number of clusters. Forming optimal number of clusters improves network lifetime, energy efficiency, and scalability.

3.3Processes of the Mobile Element (ME): The ME has the following four processes in total: MoveAround, SpawnTinyBee, SendRREQ and GetTinyBee. Basically, the ME keeps running a function MoveAround to walk around sensor nodes until the end of a network, while a function SpawnTinyBee is called to dispatch TinyBee to a sensor node periodically for some intervals. Then, the robot records the location of the node where it dispatched TinyBee. This information is used later in a function SendRREQ to broadcast an RREQ message when the robot reaches the end of the network. Finally, the robot gets ready to receive one TinyBee with aggregated data from the sensor node by invoking a function GetTinyBee.

3.4Processes of TinyBee: TinyBee has the following four processes executed on a sensor node: Migrate, CollectData, Head2ME *and,* AggregateData. After being created and dispatched by the ME, TinyBee runs a function Migrate to move on to a neighboring CH node according to a deterministic itinerary. Once TinyBee visits a CH sensor node, it runs a function CollectData to gather data from the visited CH node. After collecting data, Migrate method runs again to migrate from CH node to CH node. These two procedures are repeated in order until TinyBee finishes its itinerary where TinyBee returns to a starting node. After completing its trip, TinyBee stays on the present point until a route to the convergent node is formed by checking a routing table of the node., a function AggregateData is invoked.

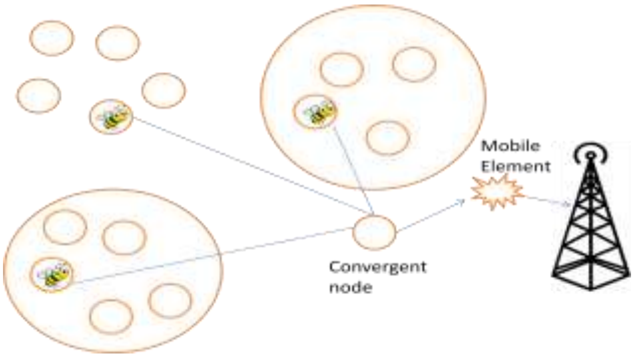

Fig:1 Process of mobile element to tinybee

3*.5 Processes of CH Sensor Nodes*: A CH sensor node transmits and receives TinyBee as well as a RREQ message. Since TinyBee already has its own itinerary to collect data, the CH node simply sends it to the next node according to the itinerary after executing TinyBee's code. If the CH node is the end point of the itinerary,It keeps TinyBee until receiving an RREQ message.After receiving an RREQ message, if the node is the destination indicated in the RREQ message, it transmits TinyBee like a conventional data packet. Otherwise, the node looks up its own routing table and checks a route to the destination. If the node has the route to destination,the RREQ message is discarded on the node. If not, the routing table is updated with the RREQ message. After that, the node forwards the RREQ message to all its neighboring nodes. The remaining energy on a node would be checked before updating a routing table on each node. In addition to the above-mentioned routines, a sensor node has to undertake a special procedure when it is selected as the convergent node by the robot. Specifically, one of the outer nodes in the network executes this procedure since the robot selects a node from the outer nodes whenever the robot reaches the end of the network. After a node is selected as a convergent node by the robot, the convergent node receives data containing the location of nodes where the robots dispatched TinyBee. Then, the convergent node broadcasts an RREQ message to find a route to these nodes. As soon as it successfully obtains TinyBee from other nodes, it executes TinyBee to aggregate all data brought by TinyBees. After acquiring all TinyBees dispatched by the robot, the convergent node transmits one TinyBee with aggregated data to the robot.

IV. Performance Evaluation

In our simulations, the 36 number of sensor nodes are deployed. They are randomly deployed in a region the size of 3000 X 3000. In each sensor, data packets are generated according to a Poisson process with the same parameter to very low traffic load; the nodes have a transmission range (rc) of 250 m and a data rate of 50 kbps. The size of the packet is deter-mined by the size of the data payload and by the space required to include the information of the next-hop forwarder set. We consider that data packets have a payload of 150 bytes.

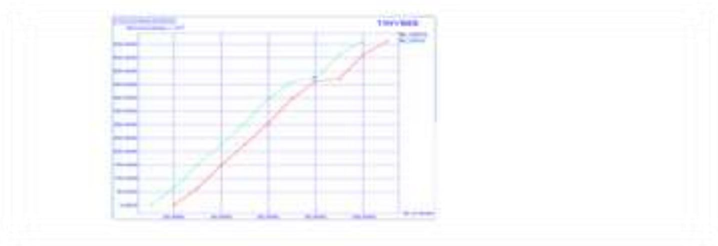

Fig 2:Comparison of network lifetime

V. Conclusion

In the proposed scheme, energy efficient based data gathering through clustering achieves energy efficiently and reduces the latency in data gathering.The dispatch of tinybees by mobile element reduces the tour length of the Mobile element. The proposed work is determined based on delay and energy. The proposed work achieves increased network life time due to less energy utilized than other algorithms. The future enhancement is to apply multiple mobile elements which in turn dispatch multiple tinybees for efficient gathering of data in large sensor network.

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