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Improvement Wsn Protocol Performance in Modified Genetic Algorithm

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Abstract- Wireless sensor networks (WSNs) has recently drawn lots of attention due to its application in multiple domains. The sensors have limited power sources and in many applications they cannot be recharged or replaced due to hostile nature of the environment. Finding near optimal solutions for the energy problem is still an issue in WSNs. A new era is opened with algorithms inspired by nature to solve optimization problems. In this paper, we propose genetic algorithm based approaches for clustering and routing in WSNs. The objective of this mechanism is to prolong lifetime of a sensor and increase the quality of service. We perform extensive simulations of the proposed algorithms.

Keywords- Wireless Sensor Networks; WSN; Bio-Inspired; Genetic Algorithm; LECR-GA; Clustering; Routage; Network Lifetime

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I. INTRODUCTION

Recent advancement in wireless communication and electronics has enabled the development of low-cost, low-power multifunctional miniature devices for use in remote sensing applications. Such sensors can be widely deployed for commercial, civil and military applications such as surveillance, vehicle tracking, climate and habitat monitoring intelligence, medical and acoustic data gathering. A WSN is composed of large number of sensor nodes which consist of sensing, data processing and communication capabilities. Usually sensor nodes are scattered in the sensing field.

They coordinate among themselves to get information about the physical environment. The information is routed to the Base Station either directly or through other sensor nodes. The BS is either a fixed or mobile node which is capable to connect the sensor network to the internet where user can access and process data.The key challenge in sensor networks is to maximize the lifetime of sensor nodes due to the fact that it is not feasible to replace the batteries of thousands of sensor nodes. Therefore, computational operations of nodes and communication protocols must be made as energy efficient as possible. Area coverage and data aggregation [6] techniques can greatly help conserve the scarce energy resources by eliminating data redundancy and minimizing the number of data transmissions. Therefore, data aggregation methods in sensor networks are extensively investigated in the literature [6], [7], [8] and [9].

Considering the challenges of WSN many routing protocols have been already proposed for WSN. They can be classified into flat, hierarchical and location-based network routing. In flat routing all nodes are typically assigned equal roles or functionality. SPIN (Sensor Protocols for Information via Negotiation) [1] and DD (Directed Diffusion) [2] fall in this category. In hierarchical routing the network is divided into clusters to achieve energy efficiency. LEACH [5], TEEN [3], APTEEN [4] are well known hierarchical routing protocol. In location based routing exact position of a node is used to find the optimal routing path e.g. GAF (Geographic Adaptive Fidelity) [10] and GEAR (Geographic and Energy Aware Routing) [1].

II. WIRELESS SENSOR NETWORK

Wireless sensor networks are potentially one of the most important technologies of this century. Recent advancement in wireless communications and electronics has enabled the development of low-cost, low-power, multifunctional miniature devices for use in remote sensing applications. The combination of these factors have improved the viability of utilizing a sensor network consisting of a large number of intelligent sensors, enabling the collection, processing analysis and dissemination of valuable information gathered in a variety of environments. A sensor network is composed of a large number of sensor nodes which consist of sensing, data processing and communication capabilities. Sensor network protocols and algorithms must possess self-organizing capabilities. Another unique feature of sensor networks is the cooperative effort of sensor nodes. Sensor nodes are

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suitable with an onboard processor. Instead of sending the raw data to the nodes responsible for the fusion, they use their processing abilities to locally carry out simple computations and transmit only the required and partially processed data.

Problem statement

Wireless sensor network uses a wide variety of application and to impact these applications in real world environments, we need more efficient protocols and algorithms. Designing a new protocol or algorithm address some challenges which are need to be clearly understood [4]. These challenges are summarized below:

• Physical Resource Constraints: The most important constraint imposed on sensor network is the limited battery power of sensor nodes. The effective lifetime of a sensor node is directly determined by its power supply. Hence lifetime of a sensor network is also determined by the power supply. Hence the energy consumption is main design issue of a protocol. Limited computational power and memory size is another constraint that affects the amount of data that can be stored in individual sensor nodes. So the protocol should be simple and light-weighted. Communication delay in sensor network can be high due to limited communication channel shared by all nodes within each other's transmission range.

• Ad-hoc deployment: Node deployment in WSNs is application dependent and affects the performance of the routing protocol. The deployment can be either deterministic or randomized. In deterministic deployment, the sensors are manually placed and data is routed through pre-determined paths. However, in random node deployment, the sensor nodes are scattered randomly creating an infrastructure in an ad hoc manner. If the resultant distribution of nodes is not uniform, optimal clustering becomes necessary to allow connectivity and enable energy efficient network operation. Inter-sensor communication is normally within short transmission ranges due to energy and bandwidth limitations. Therefore, it is most likely that a route will consist of multiple wireless hops.

Solution to the Challenges

There are many existing protocol, techniques and concepts from traditional wireless network, such as cellular network, mobile ad-hoc network, wireless local area network and Bluetooth, are applicable and still used in wireless sensor network, but there are also many fundamental differences which lead to the need of new protocols and techniques [2].

There are many existing protocol, techniques and concepts from traditional wireless network, such as cellular network, mobile ad-hoc network, wireless local area network and Bluetooth, are applicable and still used in wireless sensor network, but there are also many fundamental differences which lead to the need of new protocols and techniques. Some of the most important characteristic differences are summarized below:

• Number of nodes in wireless sensor network is much higher than any traditional wireless network. Possibly a sensor network has to scale number of nodes to thousands. Moreover a sensor network might need to extend the monitored area and has to increase number of nodes from time to time. This needs a highly scalable solution to ensure sensor network operations without any problem.

• Due to large number of sensor nodes, addresses are not assigned to the sensor nodes. Sensor networks are not address-centric; instead they are data-centric network. Operations in sensor networks are centered on data instead of individual sensor node. As a result sensor nodes require collaborative efforts.

• Sensor nodes mainly use a broadcast communication paradigm, whereas most ad hoc networks are on point-to-point communications.

• Sensor nodes are much cheaper than nodes in ad hoc networks.

• Wireless sensor networks are environment-driven. While data is generated by humans in traditional networks, the sensor network generate data when environment changes. As a result the traffic pattern changes dramatically from time to time. Sensor networks are mainly used to collect information while MANETs (Mo-bile Adhoc Networks) are designed for distributed computing rather than information gathering.

III. LITERATURE SURVEY

Vinay Kumar, Sanjeev Jain and Sudarshan Tiwari et al. [1] To maximize network lifetime in Wireless Sensor Networks (WSNs) the paths for data transfer are selected in such a way that the total energy consumed along the path is minimized. To support high scalability and better data aggregation, sensor nodes are often grouped into disjoint, non overlapping subsets called clusters. Clusters create hierarchical WSNs which incorporate efficient utilization of limited resources of sensor nodes and thus extends network lifetime. The objective of this paper is to present a state of the art survey on clustering algorithms reported in the literature of WSNs. Our paper presents a taxonomy of energy efficient clustering algorithms in WSNs. And also present timeline and description of LEACH and Its descendant in WSNs.

Minhas, A.A., Trathnigg, T., Steger, C.; Weiss, R., et al. [2], Embedded networks of wireless sensor nodes are representatives of pervasive computing. They reflect the pervasive computing proactive goal, "all the time everywhere". Mostly, they are battery operated. Due to the embedded nature of sensor nodes, power supply and its management remain an active challenge for scientists and engineers. Energy utilized in these nodes can be managed and saved at different layers of the network design. Network layer, responsible to route the data, has also a big contribution in saving the energy.

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In this paper, we discuss an application of wireless sensor networks that senses the environment pervasively. For this application we introduce a routing algorithm for the network layer. We present an innovative cross-layer design of network layer and medium access layer that carries energy saving technique for pervasive wireless sensor networks. This technique includes the sleep mode of radio and microcontroller of the nodes. We use research platform comprised of mica2 motes. We present results of our experiments by implementing temperature sensing application that includes our routing algorithm and energy saving technique. Results show 40 times reduction in average energy utilized per node. This increases the life time of pervasive wireless sensor network. For cross verification we also use simulators, TOSSIM and Power TOSSIM.

Zaballos, A.; Vallejo, A.; et al. [3], Wireless sensor networks are a collection of small devices known as sensors. These Sensor nodes have some limited resources such as cache, strength, and potential. To design a network every sensor network should be connected to each sensor so that the communication can take place between every node. This communication process consumes lots of energy. So it is necessary to develop a powerful and energy efficient protocol to increase the lifespan of the whole network. These protocols can work as routers and also reliable in multi-hop communication. This paper will give a brief introduction on various routing protocol such as hierarchical, location based and data-centric. It will also give a review on advantage, disadvantages, limitations and strengths.

Sarjoun S. Doumit, Dharma P. Agrawal: et al. [4] In this paper, our focus is on improving the energy consumption of sensor nodes in large networks. A sensor's durability and reliability depend on its battery's capacity and on the energy consuming tasks it performs in order to fulfill its functions. To achieve this goal, we propose a new "biomorphic" paradigm that imports solutions to existing engineering problems from the biological world. We show that this paradigm offers better solutions through the introduction of an additional type of sensor node and allowing the network to self-organize and "learn". This allows the network to perform better in a dynamical environment in accordance to its acquired knowledge. Simulation results show an improvement in energy utilization, and therefore, an increase in the life of the sensors and their networks.

Prabhat Kumar and M. P. Singh , et al.[5] Clustering techniques help to prolong the life of wireless sensor network, especially in hostile environment where battery replacement of individual sensor nodes is not possible after their deployment in the given target area. Clustering techniques also provide good load balancing, and in-network data aggregation. This paper introduces and analyzes a new clustering protocol in the wireless sensor networks based on energy band. The entire target area is divided into energy band which enables a node to estimate the energy with which it can transmit to the head node and head node to another head node towards a base station resulting in a prolonged life for the wireless sensor networks.

I. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, et al. [6] The advancement in wireless communications and electronics has enabled the development of low-cost sensor networks. The sensor networks can be used for various application areas (e.g., health, military, home). For different application areas, there are different technical issues that researchers are currently resolving. The current state of the art of sensor networks is captured in this article, where solutions are discussed under their related protocol stack layer sections. This article also points out the open research issues and intends to spark new interests and developments in this field.

Thomas Watteyne, AntonellaMolinaro, Maria GraziaRichichi and MischaDohler, et al. [7] In large networks, a data source may not reach the intended sink in a single hop, thereby requiring the traffic to be routed via multiple hops. An optimized choice of such routing path is known to significantly increase the performance of said networks. This holds particularly true for wireless sensor networks (WSNs) consisting of a large amount of miniaturized battery-powered wireless networked sensors required to operate for years with no human intervention. There has hence been a growing interest on understanding and optimizing WSN routing and networking protocols in recent years, where the limited and constrained resources have driven research towards primarily reducing energy consumption, memory requirements and complexity of routing functionalities.

To this end, early flooding-based and hierarchical protocols have migrated within the past decade to geographic and self-organizing coordinate-based routing solutions. The former have been brought to standardization through the Internet Engineering Task Force (IETF) Mobile Ad-hoc Networks (MANET) working group; the latter are currently finding their way into standardization through the IETF Routing Over Low power and Lossy networks (ROLL) working group.

This article thus surveys this paradigm shift for routing in WSNs and, unlike previous milestone surveys, follows a rather chronological organization within the given protocol taxonomy. For each protocol family, we provide a didactic presentation of the basic concept, a discussion on the enhancements and variants on that concept, and a detailed description of the latest state-of-the-art protocols of that family. We believe that this organization sheds some light on the design choices of emerging IETF ROLL protocols and also provides design parameters of interest to the WSN

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engineer, essentially enabling the design and implementation of more reliable and efficient WSN solutions.

M. P. Singh and M. M. Gore, et al.[8], In this paper, we propose an energy-efficient clustering protocol for wireless sensor networks. The wireless sensor network can be represented by virtual groups known as clusters. In comparison with tree-based wireless sensor networks, clustering is an effective technique for prolonging sensor network life, and for load balancing. The proposed protocol runs in a distributed environment. There are two important parameters, namely hold back (t), and number of hops (h) in the proposed algorithm. The proposed protocol forms clusters at a distance of at most h hops from the cluster head. Every node initializes its hold back value with a randomly generated value.

The size of the cluster depends on the value of h. In comparison to Adaptive clustering protocol, the new protocol avoids broadcasting cluster messages unnecessarily. The sensor node with t = 0, becomes the cluster head and broadcasts a cluster message to form a cluster. In the proposed algorithm, every node does not start broadcasting. The proposed algorithm reelects cluster heads during maintenance phase. Hence, this algorithm adapts to the dynamic nature of the wireless sensor networks. The simulation results demonstrate that the proposed protocol reduces energy consumption.

I. F. Akyildiz and W. Su and Y. Sankarasubramaniam and E. A. Cayirci, et al.[9] This paper describes the concept of sensor networks which has been made viable by the convergence of micro-electro-mechanical systems technology, wireless communications and digital electronics. First, the sensing tasks and the potential sensor networks applications are explored, and a review of factors influencing the design of sensor networks is provided. Then, the communication architecture for sensor networks is outlined, and the algorithms and protocols developed for each layer in the literature are explored. Open research issues for the realization of sensor networks are also discussed.

Problem Identification

Observation of Various research work and Article collection of problem identification as following some point-

1. Energy most of the problem to WSN communication system.
2. Essential requirement of Battery life time.
3. Number of multi iteration criteria.
4. Node allocation and distance minimization problem.

- Energy Considerations: Energy is very important parameter during the creation of an infrastructure, and the process of selecting the routes for transmission. Since the transmission power of a wireless radio is proportional to distance squared or even higher order in the presence of obstacles, multihop routing will consume less energy than direct communication. However, multihop routing introduces significant overhead for topology management and medium access control. Direct routing would perform well enough if all the nodes were very close to the sink[9]. However most of the time sensors are scattered randomly over an area of interest and multi-hop routing becomes unavoidable.
- Data Aggregation/Fusion: Since sensor nodes might generate significant redundant data, similar packets from multiple nodes can be aggregated so that the number of transmissions would be reduced. Data aggregation is the combination of data from different sources by using functions such as suppression (eliminating duplicates), min, max and average [6]. Some of these functions can be performed either partially or fully in each sensor node, by allowing sensor nodes to conduct in-network data reduction [8]. Recognizing that computation would be less energy consuming than communication [4], substantial energy savings can be obtained through data aggregation. This technique has been used to achieve energy efficiency and traffic optimization in a number of routing protocols [8]. In some network architectures, all aggregation functions are assigned to more powerful and specialized nodes. Data aggregation is also feasible through signal processing techniques. In that case, it is referred as data fusion where a node is capable of producing a more accurate signal by reducing the noise and using some techniques such as beam forming to combine the signals [9].
- Security Implementation: Security is data communication is main concerning parameter for providing secure communication in sensor networks, while designing wireless networks, as wireless sensor networks may be deployed in hostile areas such as battlefields .therefore, design of protocol should work with the data communication security protocols, as any conflict between these protocols might create challenge in network security.
- Network Dynamics: There are three basic components, sensor nodes, sink and user which is monitored the events in a sensor network. Most of the network architectures assume that sensor nodes are stationary. Some application are required the mobility of sinks or cluster- heads (gateways). Routing messages from or to moving nodes is more challenging since route stability becomes an important optimization factor, in addition to energy, bandwidth etc. The sensed event can be either dynamic or static depending on the application.

Motivation

Recent advances in wireless communication lead to many improvements in application specific wireless sensor network (WSN) deployment. Sensing different data from different environments is essential to monitor and control the situations. For instance, it is very important to sense the forest fire as early as possible to control the upshot. So efficient and timely gathering of the data from a network of small sensor nodes is necessary.

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In WSN, the small sized sensor nodes are working with very small batteries with limited energy. Since those are randomly deployed over a wide area, replacement of battery or recharging is not feasible. So, for getting prolonged life time of WSN, energy efficient operation is the key factor. Among many protocols proposed for enhancing the life time of WSN, the clustering based hierarchical protocols are popular and gaining the attention of researchers because of their high energy efficiency. Low Energy Adaptive Clustering Hierarchy (LEACH) is energy efficient hierarchical, clustering based protocol. It is considered as the base of many hierarchical clustering protocols. In this paper, some of the recent tailored protocols proposed to strengthen LEACH are examined.

In wireless sensor network energy is mainly consumed for three purposes – data transmission, signal processing and hardware operation. It is said that 70% of the energy is consumed in data transmission only. So to maximize the network lifetime data transmission is optimized by using energy-efficient routing protocols. Since the energy required is proportional to the square of distance between the communicating parties, so multi-hop routing needs less energy in compare to direct communication. But maintenance of network topology is an extra overhead in multi-hop routing. So if sensor nodes are close enough to the Base Station direct communication is the best choice due to its simplicity and less overhead. But in most cases sensor nodes are randomly scattered so multi-hop routing cannot be avoided.

IV. CONCLUSION

Use of the wireless channel is growing at an amazing speed. Advances in energy-efficient design have created new portable devices that enable exciting applications for the wireless channel. While the wireless channel makes deployment task easier, it adds constraints that are not found in a wired environment. Specifically, the wireless channel is bandwidth-limited, and the portable devices that use the wireless channel are typically battery-operated and hence energy-constrained. In addition, the wireless channel is error-prone and time-varying. Therefore, it is important to design protocol and algorithms for wireless networks to be bandwidth and energy-efficient as well as robust to channel errors.

There is still much work to be done in the area of protocols for wireless micro sensor networks. The protocols described in this dissertation are for scenarios where the sensors have correlated data. However, there are important applications of wireless sensor networks where this is not the case. For example, sensor networks for medical monitoring applications may have different sensors located on and/or in the body to monitor vital signs. These networks will not be as large-scale as the ones discussed, but they will have similar requirements to the sensor networks discussed – long system lifetime, low-latency data transfers and high quality data. These networks will most likely focus on maximizing quality above all parameters and loss of information will not be acceptable. Therefore protocol architectures need to be developed to support the unique considerations of these networks.

Finally it will be important to develop secure communication for wireless sensor networks. End-users need to be able to ensure unauthorized users cannot access the data from the sensor networks. Furthermore end-users need to be able to authenticate the data. Application-specific and scalable solutions may be able to provide the level of security required without draining the node's limited energy. Without these security measures in place, the application of sensor networks will be limited. Use of the wireless channel is creating at an amazing pace. Advances in essentialness profitable structure have made new advantageous contraptions that engage empowering applications for the wireless channel.

While the wireless channel makes sending task more straightforward, it incorporates goals that are not found in a wired area. Specifically, the wireless channel is information transmission confined, and the advantageous contraptions that usage the wireless channel are generally battery-worked and from now on imperativeness constrained. Additionally, the wireless channel is screw up slanted and time-fluctuating. Right now, is basic to design show and computations for wireless frameworks to be information move limit and imperativeness viable similarly as enthusiastic to channel bumbles. The work portrayed right now an essentialness gainful directing method which is generally proper for application like condition checking where sensor center points arranged in near to locale accumulate equivalent sort of data.

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