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Review of Energy-Efficient Wireless Sensor Network using Routing Protocol Approaches

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ABSTRACT: The widespread use of wireless sensor devices and their advancements in terms of size, deployment cost, measurement of environmental events and user friendly interface have given rise to many applications of wireless sensor networks (WSNs). WSNs are usually characterized as self-organizing networks which can be deployed without requiring any specific infrastructure in harsh and/or hostile area. In this paper are studied of different types of clustering protocol favors higher period in lieu of overall network lifetime. In cluster, a predetermined number of CHs are selected in deterministic fashion on the basis of residual energy of nodes. The focus is to balance the load among nodes and provide full network coverage.

KEYWORDS:- Wireless Sensor Network, Cluster Head, Routing Protocol

I. INTRODUCTION

Recently the advancement of wireless sensor networks (WSNs) has opened up a whole new fascinating field for the implementation of new technologies in deployment of WSNs. By the next decade, the Wireless Sensor Network (WSN) is expected to be linking billions of devices, where devices interact with each other without human interference. Contact between devices is unique to the application and the wireless sensor network provides the internet with a backbone for application results [1]. WSNs are an excellent option for a broad variety of applications, since they can sense the world, contact neighbouring nodes and perform simple calculations on the collected data in various circumstances. Initially wireless sensor networks were used for military surveillance but later the applications were extended to other fields such as industrial manufacturing, health monitoring, ecosystem monitoring, and environmental monitoring. Another few applications enabled by WSNs include agricultural and vegetation monitoring, remote sensing, weather prediction, volcanic activity surveillance, military surveillance, traffic state updates, and biological monitoring systems. Geoinformatics (GIS) and smart transportation system (ITS) are quite distinct categorized uses of WSN [2]. The network market for wireless sensors was projected at US\$ 46.76 billion in 2019 and is expected to hit US\$ 123.93 billion by the year 2025, with a CAGR (annual growth rate) of around 17.64 percent within the estimate period of 2020-2025 (Fig. 1) [3].

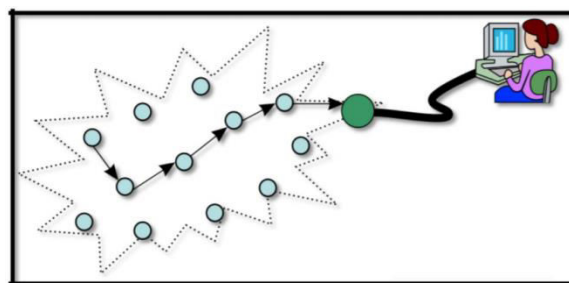


Fig. 1: WSN

Wireless sensor network comprises of a vast amount of small sensor node which analyses their surroundings, process data (utilizing microcontrollers) as well as send/receive processed information from/to other neighbouring sensor nodes as needed. Several of these sensor nodes are dispersed around and are linked through the networking system to a base station

(BS) in the centralized tree, mesh or other topology or to another sensor network. The sink gathers data from the sensors for the destination in centralized networks. In many instances, the base station is also able to turn on sensor endpoints by transmitting access control as well as monitor data through connected channels. Since WSN is not just comprised of wireless sensor nodes, it is a base station (BS) or sink node that contributes most to the wireless sensor networks. In WSN, the nodes are battery powered; thus, energy supply limitation has inspired a lot of research in the design of an energy effective device. The design of the energy effective routing techniques is therefore important for improving the network lifetime [4][5]. WSNs have a short range of communications, scalability as well as energy efficiency, since in many instances, SNs will squander their energy, data transfer is one of the most wasteful sources of energy and thus routing is an important method. Due to energy constraints and restrictions on communication range, it is important to identify and maintain routes in WSNs. The creation of an energy effective WSN network architecture is main paradigm to prolong the network lifetime [6][7].

II. ROUTING ALGORITHM

Considering various issues and challenges of routing in sensor communications, various novel algorithms/protocols are proposed to for efficient routing in sensor networks. Fig. 2 demonstrates the types of routing algorithms. Routing algorithms can be classified into following two major categories:

Nonadaptive Routing Algorithms: Nonadaptive routing algorithms don't take routing decision on basis of measurements and estimates of current traffic and topology.

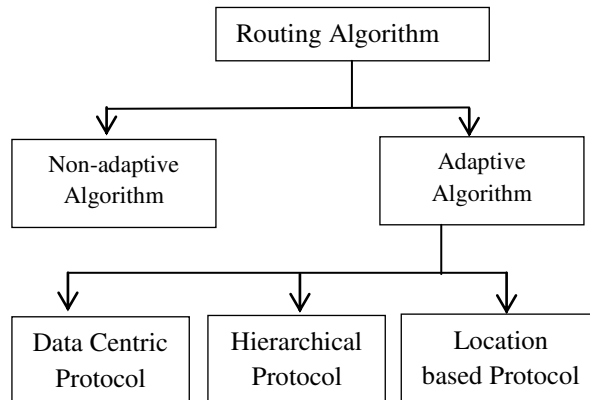


Fig. 2: Classifications of Routing Algorithms

The routing path from node to node is determined in advanced, off-line and downloaded to routers when booting of network is performed. Non-adaptive routing is also known as static routing. In terms of static routing, any change in topology or loss of link, the node is not compensated, which means either packet transmission would be halted or repaired or restarted.

Adaptive Routing Algorithms: Most of wireless communication networks makes use of Adaptive routing algorithms. The Adaptive routing algorithms (Dynamic Routing Algorithms) change their respective routing decision with regard to any sort of change in network topology and traffic load. Adaptive routing mainly defines the ability of the system, in calculating the optimized routes from source to destination and to modify the path the route takes through the system with regard to changing conditions. Adaptive routing is basically designed to allow as many as routes as possible to cope up with packet loss, in response to any sort of change in the network. Adaptive routing is utilized in networking to describe the ability of network to make changes in route discovery, path establishment and data transfer between nodes.

III. LITERATURE REVIEW

Xingjin Wang et al. [1], WSNs have been progressively intrigued by industry and scholarly cycles for their expected use in applications like natural observing also, military reconnaissance, etc. The paper thinks about the energy requirements of bunched WSNs and proposes an improved directing convention for such WSNs to accomplish a worldwide streamlining in energy utilization for all group head hubs, which diminish the impacts of problem areas in certain hubs close to the sink hub and forestall the hot head hubs to be over-burden for information correspondence. In such a steering convention, a period arranged rivalry calculation is utilized to choose bunch head hubs for a running WSN to lessen the unique geography of transmission message among sensor hubs rather than arrangement instrument, which is pointed toward lessening network traffic troubles. Besides the distance among hubs and the sink hub as a crusade record are considered to decrease the inconsistent power circulation of bunches' hubs in WSNs oversee by the conventions, which help to uniform devouring energy, all things considered, in a WSN somewhat. The hubs in a group choose their head hub by considering the distance between their correspondence position and up-and-comer group head hubs, for which the proposed convention ensures a sane size of the bunch. The tale convention calculation is tried by a Matlab reenactment program. Contrasted and the customary LEACH (Low-Energy Adaptive Clustering Hierarchy) calculation and EEUC (Energy-Efficient inconsistent Clustering) calculation, the reproduction results show that the improved steering convention is more steady to lessen the entire energy utilization of a WSN with more adjusted correspondence stacks and broadens the organizations' life time.

NashreenNesa et al. [2], energy conservation is a challenging concern with the growing advancement in Internet of Things (IoT) technologies and is currently one of the attractive issues among researchers working in the IoT domain. In this paper, they address this issue by devising a dynamic sensor activation algorithm inspired by the popular PageRank algorithm called SensorRank. Unlike PageRank algorithm which only requires the outlinks to rank webpages, SensorRank, on the other hand, dynamically analyses the network topology in terms of relative distances and link qualities between devices and the remaining energies of the devices, based on which the sensors are ranked. Optimal subsets of sensors are activated that take part in data fusion and the inactivated sensor data are regenerated with the help of Compressing Sensing technique.

Xiuwen Fu et al. [3], in these routing protocols the routing survivability under harsh environments is questionable. To tackle this issue, in this paper by referencing the concept of potential field, they design an environment-cognitive multipath routing protocol (ECMRP) in order to provide sustainable message forwarding service under harsh environments. In ECMRP, routing decisions are made according to a mixed potential field in terms of depth, residual energy and environment. The basic idea of this approach is to instruct data packets to select routes with the tradeoff among latency, energy conservation and routing survivability. As the environmental field is constructed and updated using the sensing capability of WSN itself, constructed routes can avoid crossing through the danger zones to keep the paths safe. The experimental results show that ECMRP can obtain significant improvements in packet delivery ratio and network lifetime under harsh conditions.

Da-Ren Chen et al. [4], to effectively save energy and prolong network lifetimes, networks typically adopt clustering protocols with hierarchical inter-cluster topologies for network management and data acquisition in WSNs. However, such solutions require cluster re-configuration due to early death of cluster heads (CHs) and energy inefficiency. This paper proposes a coverage- and energy-aware protocol with intra- and inter-cluster methods called CEMST based on newly defined parameters for sensor overlapping and node density functions. In addition, to adapt network dynamics while improving energy efficiency, a self-stabilizing algorithm is proposed with the Boruvka algorithm to respectively construct minimum spanning trees (MST) for intra- and inter-cluster routes.

Wael Ali Hussein et al. [5], have been designed for scalar data such as sensor data; which is small in size compared to multimedia data. The addressed challenges were the motivation to design mobile reliable routing protocol based on greedy routing structure. In this paper, we propose a new routing protocol for greedy forwarding based on throughput energy aware multi-path routing protocol(GFTEM), which is based on selection of next hop node that has the highest throughput and closer to destination node. GFTEM performance is seen and compared against Ad hoc on-demand distance vector routing protocol (AODV), Dynamic MANET on-demand routing protocol(DYMO) and greedy perimeter stateless routing for wireless networks (GPSR).

Hsiang-Hung Liu et al. [6], one of the confinements of a WSN is its constrained sensor hub vitality asset; this requires a vitality proficient steering convention that amplifies the general framework execution. Gossip directing is a great arbitrary walk steering convention that, tragically, isn't adaptable and can result in winding ways. They think about that the most brief separation between two is a straight line and that two straight lines in a plane are probably going to converge and create for WSNs an improved convention called straight-line steering (SLR), in which we build a straight way utilizing two-bounce data without the help of geographic data. SLR along these lines diminishes the vitality utilization of sensor hubs in WSNs. They propose upgraded plans to improve execution and monitor more vitality and, with broad reenactment results, show the viability of these SLR plots in examination with talk steering.

AkshayVerma et al. [7], have proposes a Grid and Fuzzy based Stable Energy-efficient Clustering (GFSEEC) Algorithm for Heterogeneous Wireless Sensor Networks (WSNs). It provides better stability period, throughput and network life time than LEACH, SEP and DEEC Protocols. This algorithm significantly improves the performance of two level as well as multilevel heterogeneous WSNs. It has been observed that with increase in stability period, lifetime of network reduces i.e. there is trade-off between stability period and network lifetime. Also the throughput of network is affected by stability period. Thus to provide better trade-off between stability period and network lifetime, this work has been further carried out in proposed GFSEEC algorithm.

Uday Kumar Rai et al. [8], this paper present the application of Maximum Likelihood Estimation (ML) algorithm for the cluster head selection with an unequal clustering protocol. In wireless sensor network it is generally found that each sensor node has their own limitation of power source which is generally not rechargeable. Therefore, an energy efficient clustering, routing and transmission scheduling has been always a priority that reduces the energy hole problem and increase the network lifetime.

Zhangbing Zhou et al. [9],with the development of the Internet of Underwater Things, shrewd things are sent under the water and structure the submerged remote sensor systems (UWSNs), to encourage the disclosure of huge unexplored sea volume. A steering convention, which isn't costly in bundles sending and vitality utilization, is central for tactile information assembling and transmitting in UWSNs. As a rule, CARP does not consider the reusability of recently gathered tactile information to help certain area applications a while later, which initiates information bundles sending which may not be gainful to applications. These two research issues have been tended to by our E-CARP. Reenactment results approve that our method can diminish the correspondence cost fundamentally and increment the system capacity partially.

Mohammed Abo-Zahhad et al. [10], have mobile sink-based adaptive immune energy-efficient clustering protocol (MSIEEP) to alleviate the energy holes. A MSIEEP utilizes the versatile insusceptible calculation (AIA) to manage the portable sink-dependent on limiting the all out disseminated vitality in correspondence and overhead control parcels. Additionally, AIA is utilized to locate the ideal number of group heads (CHs) to improve the lifetime and strength time of the system. The execution of MSIEEP is contrasted and the recently distributed conventions; to be specific, low-vitality versatile grouping chain of importance (LEACH), hereditary calculation based LEACH, alter LEACH, meeting, and portable sink improved vitality productive PEGASIS-based directing convention utilizing MATLAB. Reenactment results demonstrate that MSIEEP is progressively dependable and vitality productive as contrasted and different conventions.

Marwan Al-Jemeli et al. [11],presents a cross-layer activity model that can improve the vitality utilization and framework throughput of IEEE 802.15.4 MWSNs. The proposed model coordinates four layers in the system task: 1) application (hub area); 2) arrange (directing); 3) medium access control (MAC); and 4) physical layers. The area of the versatile hubs is inserted in the directing activity after the course revelation process. The area data is then used by the MAC layer transmission control to modify the transmission scope of the hub.

IV. PROBLEM FORMULATION

The major concern while designing and planning WSNs operation is energy consumption. Therefore, it is important to be aware regarding the residual energy and configuration of power consumed by different components of SNs. It is equally important to study the efficient algorithms that assist the organization and operation of WSN effectively.

The main objective of this research work is to design and develop communication protocols for energy constrained networks to achieve energy efficiency while maintaining good energy-delay tradeoffs. The focus is on WSNs as a class of energy constrained networks which are generally static, have little or no mobility, and have limited battery supplies. Ideally, these protocols should prolong network lifetime, without overly compromising on other performance metrics that are of interest to the application. In this dissertation, novel energy efficient communication protocols are presented that not only address the limitations of existing protocols, but also achieve good tradeoffs for energy constrained networks.

V. METHODOLOGY

The sensor nodes for multiple-hops function for each and every data transfer consequently, use vast amount of energy in the previously established frameworks, which continually impacts the existence of the WSNs. Subsequently the reliability of cluster formation had become a serious problem with WSNs. High energy consumption, minimum degree of reliability may lead to fast disintegration of cluster head, ultimately leads to re-clustering at the premature time. This severely impacts the overall throughput of the wireless sensor network. In order to enhance the stability of the cluster groups a new approach is suggested, which, is EAUM-WCHR (Energy Aware unequal Multi-hop Weighted Cluster Heterogeneous Routing) routing technique. The key procedure which is incorporated in this given protocol are data aggregation, weighed unequal cluster head selection, and event-driven cluster head rotations. In WSN, a number of architecture styles are created based on the principle of energy efficiency. The network lifetime as well as energy enhancement of WSNs has been focused as the central motive for designing every transmission prototype in order to achieve high quality of operation.

Since it receives all data from the cluster child nodes as a forwarder in the current cluster and also performs the mechanism of forwarding backbone network information operation, the cluster head uses substantially more energy than the cluster child nodes. Due to the lack of cluster head rotation, an energy hole could build in the network, which may kill the local system or suppress the entire network. When a predictable daily substitution of the CH is added to the network, the control and packet propagation interference is concentrated, indicating the network's throughput. In this condition, the cluster head rotation is the possible solution for the backbone networks and also requires less amount of energy, which, is sufficient for this process. Here event-based CH rotation method is proposed with the help of the following packet definitions.

Step 1 -CH rotation-data packet, including CH label address.

Step 2 -CH rotation response information packet.

Step 3 -CH appointment packet, including CH address appointment.

Step 4 -CH lost contact data, when cluster nodes been unsuccessful to connect in the particular time period then the data packets are multicast to other cluster nodes.

Wireless Sensor Networks (WSNs) normally grouped into a large number of battery-operated units that networked together to process, control, collect and communicate data to the users. These devices are termed as motes/sensor nodes. An array of such motes deployed in a particular area (indoor or outdoor) for assimilating respective purpose form WSN. The initial advancement of WSN was inspired by military applications, such as, surveillance in the battlefield and detection of the enemy. As years passed by, significant measures of research endeavours have empowered the actual execution and as a result WSNs becomes one of the important tool for many real-life applications viz. agriculture, greenhouse, , disaster relief, target tracking, monitoring etc. The benefits offered by WSN in comparison with wired network are, less cabling, mobility, less cost of installation, automation in the factories, smart infrastructure etc. In WSN, each node in a network has capability of sensing, data gathering, processing of the data and communication to neighbouring node or sink. The sensed data's frequency, size and the quality are influenced by the physical resources available to the sensor node. Flexibility, economic viability and energy efficiency are some of the design objectives of the sensor node.

VI. CONCLUSION

Scalability is an important aspect which is used to save the energy in WSNs. The proposal which is used to save the energy for small networks consisting of few nodes can also be applicable for large network, i.e., it should be adaptive to adjust for the larger network domain. There is another parameter named stability that cannot be ignored while designing an energy efficient routing protocol. Most of protocols cited in the literature improve the operational lifetime of the network by ignoring its effect on the robustness or stability period of the network. There is a tradeoff between operational lifetime and stability period of the network, which needs to be handled wisely.

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