Enhancing Cluster Head Lifetime in Wireless Sensor Network: A Survey

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***Abstract*— In the backdrop of the Internet of Things, wireless sensor networks (WSNs) are a practical and efficient technique for gathering field data. Any WSN's lifespan is sometimes constrained by the small battery capacities that come with its cluster heads. Increasing the lifetime of WSNs by replenishing cluster head batteries via energy harvesting is becoming more and more common. This study explores a WSN scenario with cluster heads that have varied initial energies, different traffic requirements, and the ability to gather solar energy with the aim to fulfill the specifications of a practical WSN system. This paper delves into innovative methods, their workings, and exciting future possibilities.**

***Keywords*— WSN, Cluster head, Energy harvesting, Solar energy, sensor nodes.**

INTRODUCTION

A Wireless Sensor Network (WSN) is a wireless network with no infrastructure, composed of plenty of wireless sensors distributed ad hoc. It is utilized to track different systems, physical issues or environmental aspects. The prominent reasons for the evolution of wireless sensor networks are: advancements in technology with respect to energy efficiency, the necessity for seamless connectivity, the cost factor, safety and security, etc. Achieving great energy efficiency in Wireless Sensor Networks (WSNs) is critical for extending network longevity. Researchers looked into a variety of methods, involving clustering-based methodologies. These techniques make use of low-power, multi-functional sensors that collaborate with cluster heads that have data capabilities.

A major challenge in WSNs is attaining great energy efficiency in order to increase network durability, as sensor batteries have a restricted quantity of stored energy and are challenging to replace or replenish. Numerous techniques, including clustering-based ones, have been presented as answers to the problem after extensive research was conducted on it.

A clustered WSN is normally made up of a base station (BS) and a number of clusters. A cluster head (CH) with certain non-cluster head (NCH) nodes constitute each cluster. The CH is responsible for collecting data from NCHs, processing it, and then delivering it to the BS, either straightaway, via other CHs, or via different relay nodes. Relay nodes are in role for passing data extracted from additional nodes but are not always in function of local sensing.

An inconvenient CH position may compel the CH node to interact with the BS over a long distance, consuming its stored energy quickly.

ENERGY HARVESTING SYSTEM

Energy harvesting (EH) is the technique for gathering energy from outside sources. This energy is subsequently stored for use by small, wireless autonomous devices, such as those used in condition monitoring, wearable electronics, and wireless sensor networks. It can also be called as power harvesting, energy scavenging, or ambient power.

I. LITERATURE REVIEW

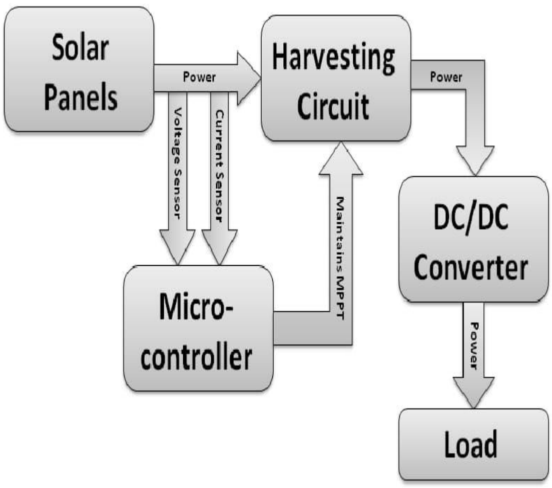

Figure 1. Basic block diagram of solar energy harvesting in Wireless sensor networks.

LITERATURE REVIEW

L Lakshmaiah et al [1] proposed that Enhanced Energy Harvesting Clustering (EEHC) system has been presented for energy harvesting aware WSN. It offered balanced energy harvesting and distribution during the cluster creation and data passing on stages. CH is elected by the Gaussian Harris Hawks Optimizer (GHHO) during the cluster building phase. Hawks chasing behaviour serve as the search agent in the GHHO algorithm, while prey serves as the ideal CH position. Since the HHO algorithm random number generation could lead to poor CH selection, the problem has been resolved by employing the Gaussian distribution function. Data from each cluster node is collected by CHS, which then sends the collected data to the BS. Following CHS, linking CM to the appropriate CH for data mediation occurs. The CM sends the CH the data it has gathered during the DT phase. CH must continue to operate in a listening state to receive data from CM. Additionally, CH accumulates the data it receives before periodically sending it to the collector. The experimental results are calculated in terms of RE, PDR, PLR, network lifetime, and average delay, it shows that the considered system functions better when contrasted to other methods. HND, whereas the results from the said system were acquired after 3241 rounds, those from the E2-MACH, FUCHAR, HMBCR, and NEHCP approaches were obtained after 1681, 1884, 2842, and 3059 rounds respectively. In order to save energy, data aggregation has been joined with the EEHC protocol in future development.

Harmandeep Kaur and Avtar Singh Buttar [2] proposed that the the finite energy of batteries combined with wireless sensor networks is a major cause, which cuts its lifetime. The method used to overcome this major limitation is the energy harvesting (EH) systems. There are number of energy sources available nowadays, but solar energy is flexible, mature and is an external power source; so, it is broadly utilised for EH in the wireless sensor network to enhance the life of the network. The solar EH technique along with the low energy adaptive clustering hierarchy protocol is applied. The charging and discharging curves of the battery and energy status of the nodes are propounded. The simulation results demonstrate that the life of the battery and the network gets augmented after applying the solar EH technique.

Maddali MVM Kumar and Aparna Chaparala [3] proposed that a hybrid algorithm for choosing the cluster head (CH) in a wireless sensor network that sums up the efficient key factors of the fruitfly optimisation algorithm (FOA) and bacterial foraging optimisation (BFO). The group foraging behaviour of bacteria like E. Coli and M. xanthus, which recognise chemical in their surroundings and move away from particular signals, serves as the model for the bacterial foraging optimisation algorithm. The FOA is a straightforward framework that is simple to use to solve optimisation problems with various characteristics. This approach, which solves discrete optimisation issues, is reliable and quick. The end-to-end latency, packet delivery, drop ratio, energy consumption, network lifetime, and throughput performance indicators of the suggested approach are assessed. According to the simulation results, the suggested approach outperforms other approaches including ant colony optimisation, particle swarm optimisation, and genetic algorithms in terms of energy efficiency and network longevity by35%,58%, and 67%.

Mahdi Zareei,et.al [4] proposed here that, we examine how EH sensors can be made to perform better and evaluated under different conditions. We design a network model that enables us to investigate many scenarios. We use the clustering information, which was shown to increase energy efficiency in traditional sensor networks, to EH sensor networks in order to examine its effect on the network's performance under various conditions. In addition, different power management for sensors is suggested and assessed in networks clustering in order to investigate how power balancing affects the final output of the network. With respect to the simulation results, gearbox power adjustment and clustering. More efficient distribution of power consumption throughout the network to a 20% increase in packet delivery ratio, a 10% increase in network lifespan due to more active nodes, and a 10% decline in delay through fewer hops.

Qian Ren & Guangshun Yao et.al [5] proposed that an energy-efficient cluster head selection framework, named EECHS, in light of the enormous energy usage during the cluster head choosing stage and the uneven gathered energy among node in energy-harvesting wireless sensor networks (EH-WSNs). One cluster's nodes are divided into three categories by the scheme: scheduling nodes (SN), cluster members (CM), and cluster heads (CH). As a way to help EH-WSNs select a suitable node as CH and enhance the energy recorded, we offer in this research an energy-efficient CH selection algorithm, named EECHS. For each cluster, EECHS chooses a node as the SN. This node holds the responsibility for collecting and storing real-time residual energy data for all CMs and the CH in that cluster. To minimize the energy used up by CH selection, the SN identifies an appropriate CM to be the new CH in each round with respect to the observed result. The primary weakness of this piece resides in the failure of not considering the relationship between the energy that sensor nodes capture from their surroundings and the energy that the nodes require for operation.

Yonghua Xiong et al [6] proposed that essential subject in Wireless sensor network (WSN) is the way to optimize the lifespan of the network at the same time as preserving the coverage Requirement. Since the energy of sensor node is restrained, the network durability is extraordinarily limited. Latest researches have confirmed that energy harvesting era can Potentially alleviate the energy difficulty. This paper focuses On the way to boom the community lifetime even as pleasurable the Full target insurance in a unique Hybrid energy-harvesting Wireless Sensor network (HEWSN) which incorporates each Static non- rechargeable sensor nodes and mobile Rechargeable ones, after which proposes a two-segment Lifetime-Enhancing technique (TLM).Inside the first segment, we appoint a Multi-goal Particle Swarm Optimization(MOPSO) Set of rules primarily based on adaptive grid for recovery coverage hole, Which relocates beneficial cell rechargeable sensor nodes at Most fulfilling places to satisfy the entire goal coverage.Inside the 2d segment, we gift a modified Binary multi- goalEvolutionary set of rules primarily based on Non- dominated Sorting And Bidirectional local seek (MBNSBLS) to time table Sensor nodes into non- disjoint subsets working in flip, Which facilitates to expand the network lifetime. Simulations are Conducted and the consequences display that TLM has greater effectiveness than rest of the approaches.

Deepak Sharma and Amol P. Bhondekar[7] introduced that energy harvesting is the significant technique for developing long-lasting and/or self-sustaining battery-powered WSNs. Another intriguing issue for establishing realistic WSN deployments is the consideration of WSN heterogeneities. Furthermore, looking into these extra characteristics in resource restricted WSNs presents novel problems in building intelligent algorithms with optimal resource use during WSN operations. These notions are included in this work for developing EHTEAR, a clustering-based routing strategy for multi-heterogeneous and energy harvesting WSN scenarios. During cluster-head selection, EHTEAR evaluates nodes' beginning energy, residual energy, traffic requirements, and energy-harvesting capabilities and beats existing algorithms like LEACH, DEEC, and TEAR in WSN's dependable lifetime (stability period) under the scenario. Intelligent routing for heterogeneous and energy-harvesting WSNs is a very relevant work for producing realistic WSNs suitable for the Internet of Things arena. Furthermore, in an IoT scenario, information available on the Internet, like a forecast of solar radiation based on a weather forecast, can aid in the development of smart routing choices reconsider nodes' future solar energy harvesting capabilities looking into the forecast. Another intriguing future study path is the modeling of energy harvesting strategies other than solar power and their optimal use in WSN routing decisions.

Abdul Rashid et.al [8] proposed that energy consumption is the fundamental obstacle with wireless sensor networks. Thus, our research focuses primarily on managing the sensor node's energy usage.The non-changeable batteries that power sensor nodes are an essential component in deciding how long the node will operate. In many applications, it is rather difficult to replace these batteries. An ultimate solution for this issue is employing a wireless sensor network's energy harvesting system to constantly power sensor nodes. Sensor nodes readily extract energy from the environment. Solar, wind, and thermal energy are just a few of the many conventional energy sources that are captured and used for WSNs. In this work, we propose to employ energy harvesting systems for wireless sensor networks based on clustering for Cluster Heads. We will contrast our suggested method with the well-known Low Energy Adaptive Cluster Hierarchy (LEACH) clustering algorithm.

Nibedita Priyadarshini Mohapatra et al [9] proposed that enhancing network lifetime is a difficult problem in wireless sensor networks. Hence, the provided energy harvesting leach model prominently increases the duration of the network, which appears to be above the expected level. At the same time, a successful clustering strategy balances the energy budget while also maintaining the network's fault tolerance capability. So the presented model is really greater than the actual models in all respect.

Pengfei Zhang et al[10] introduced so many effective clustering techniques for maximizing the period of wireless sensor networks (WSNs), or the duration of time until a specific percentage of the nodes die. These algorithms were motivated by recent improvements in WSN technology.In particular, an algorithm for optimizing a single-cluster network's lifetime is proposed, and then an extension to handle multi-cluster networks is brought up.Following that, we examine the collaborative issue of extending the endurance of a network by the addition of energy-harvesting (EH) nodes. A approach is put forth to increase in multiple folds the lifespan of the network in which EH nodes act as cluster heads('CHs') dedicated relay nodes.The suggested algorithms can efficiently reach optimal or suboptimal solutions, according to theoretical analysis and comprehensive simulation findings. As a result, they serve as helpful benchmarks for different centralized and distributed clustering arrangement patterns.

CONCLUSION

Cluster head lifetime plays important role in selection of any Wireless sensor network. More the life time, more we can rely on the network.

To modify the wireless network more dependable after many research actions authors have put forth a lot of algorithms as in the placement of Cluster head in any network.

Likewise those research works with respect to cluster head placement in any wireless sensor networks briefly concludes that the algorithms that we need to consider should make sure that the position of cluster head should be near to both the sensors and the base stations so that it uses less amount of energy during the transmission, and hence we can use major energy to process the stuffs that has been sensed via sensors.

To enhance the Cluster head lifetime along with the introduced Algorithms we can use Energy harvesting technique.

That is out of researchs it is found that on harvesting natural energy like solar energy wind energy or tidal energy in to the batteries of cluster heads according to the area of the Wireless sensor network considered.

Like that of for duckland we can make use of solar and water energy and at high altitude areas we can use of Wind energy and so on we can consider the source of natural energy based on the location.

Specifically on considering Solar energy we can make use of solar panels and thus store its energy into the Cluster heads battery.

And thus we can make use of IOT to monitor the amount of charge induced into the battery.

Henceforth we can rely on the wireless sensor network without replacing the battery on regular basis.

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