A Detailed Overview of Life Cycle Enhancing Approaches for WSN

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ANNOTATION

The major target of a wireless sensor network (WSNs) is to amass related data in the form of packets from the physical world. Transmission of these packets towards lengthier route consumes extra battery, and amplification and causes more intervening. As a result, these variables limit the lifespan of the network and operational ability. Numerous techniques exist in the past to augment the lifespan of the WSN. In this paper we have analyzed state of art techniques which enhance the lifecycle of a WSN.

KEYWORDS: *Transmission pf Information, Power Requirement, Lifecycle.*

INTRODUCTION:

In simple terms, a WSN is a disseminated network made up of motes. Sensor nodes or motes are other names for these nodes. Sensors are uniformly distributed devices that use energy from a finite supply [1]. The sensors in a WSN are ascendable, power- sufficient embedding devices in an altitudinal network that obtain, compute, and process data before it reaches the consumers [2]. The motes are small sensor devices that work together to build a dense network. A mote's primary benefit is that it can be used in various applications. This is why motes are so important in the WSN since they have so many different applications. A Transceiver is used to communicate between the motes. To get the best performance, the transceiver aids in the formation of links between the many motes in various contrasting layouts. When comparing a traditional WSN to an Ad Hoc network, the key variance is the number of nodes in each network, fig 1 illustrates an instance of WSN.

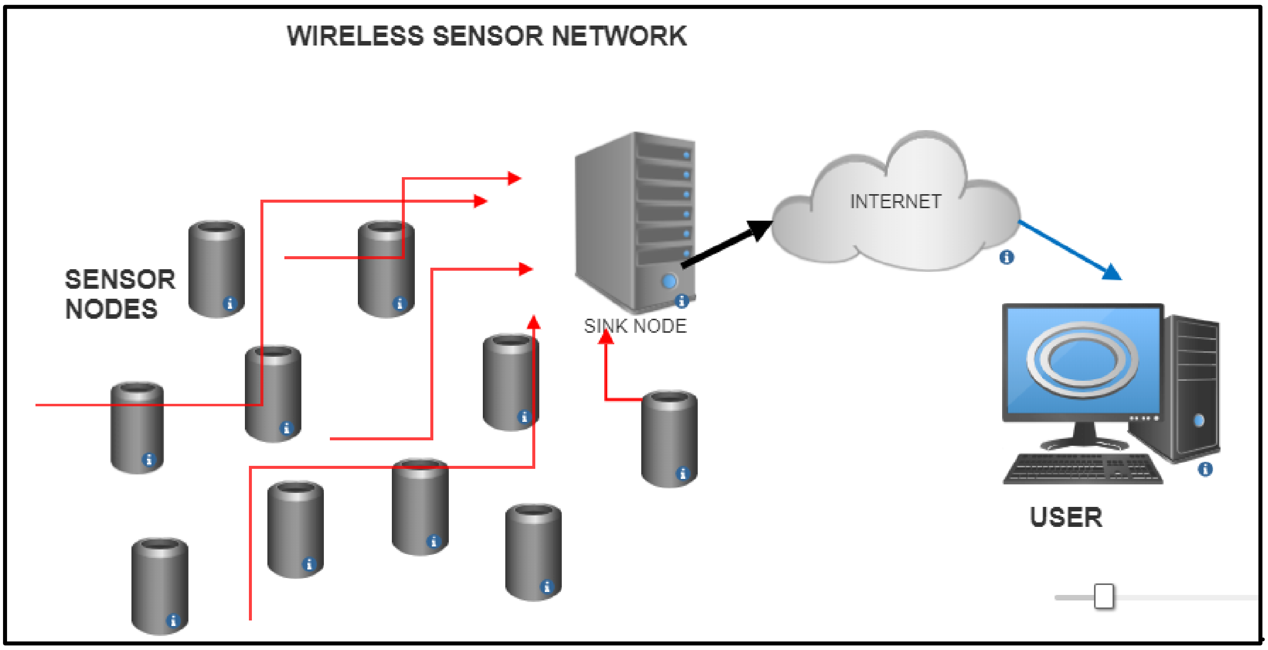

Fig 1: An instance of WSN

RELATED WORK:

The WSN is a dispersed network of supply-constrained tiny nodes that can function in the absence of users [3]. The MEMS technology has advanced quickly, resulting in compact, low-energy, minimal cost sensor motes that can detect a variety of physical and environment factors. The WSN improves people's ability to observe and control physical places from distance [4]. Because each sensor node can operate independently without the need for centralized control, the failure of a few sensors does not disrupt the operation of the entire network [5]. Unlike other forms of networks, the WSN is more reliable and secure. Each mote contains one or more moderate power sensors, a Microprocessor, storing, a source of energy, a transmitter, and an actuator [6].

Constituents of WSN

A WSN contains spatially disseminated sovereign sensors to accommodatingly observe real or ecological circumstances. The sensors link wirelessly and regularly self-organized subsequently staying planned in an ad-hoc style. A sensor-net can include many numbers of nodes, even in thousands. Source nodes convey their information to destination nodes via relay sensors. The destination node has been associated to a central gateway (known as BS). The BS offers a linking to the outside world where the data may be composed, handled, and examined.

Sensor Node/Mote

Sensor nodes are normally made of some sensors and mote component. A Sensor perceives the info and passes it on to node circuit. These are naturally employed to evaluate the variations in physical ecological factors such as hotness, compression, moisture, noise, trembling and variations in the health aspects of a human, for instance BP and heart-rate. A mote contains CPU, storage, power cell, ADC circuit for linking to a sensor and a transceiver for creating an ad-hoc infrastructure. Every sensor may assist a multi-node routing procedure and works as relay node for communicating messages to the BS. It is proficient of performing data processing, congregation and cooperating with extra linked sensors of the network.

Power Block: Every sensor mote is equipped with battery power.

Actuator An actuator is a device that is accountable for moving a sensor mote. It is an optional module of the system and uses a significant amount of energy.

Sensing Block: A sensing block has two parts, a transducer and an analog to digital converter. A transducer senses some phenomenon in the atmosphere and generates an analog signal of the physical data. This analog signal is transformed into the digital signal from the analog to digital transformed and sends to the micro-controller.

Processing Block: It contains a micro-controller which controls the other components of the sensor node. Micro controller is embedded within the sensor as it consumes low energy, programmable, cheap cost and ease of connecting to other parts of the sensor**.**

Communication Block: Transceiver is a communication component which is used to exchange data and messages between a sensor node and its neighbor via a wireless transmission medium.

CLUSTERING BASED PROTOCOLS

Clustering is a very efficient method for improving network lifetime. It reduces the power depletion and improves extensibility of the network. In clustering, nodes of the network form collections known as clusters. Nodes within a cluster convey their information to the CH, which transfer this info to the sink node. Various improvements over basic clustering technique were introduced in the review work to extend the lifespan of sensor networks.

Authors in [7] have projected an EHCS method. In this scheme, the primary energies of the sensors differ with regard to their gap from the sink. The entire area has been divided into circular rings of equal width. Sensors in separate rings have uneven initial energy. In order to avoid energy holes, only cluster heads, which are in positioned in inner circular rings, are allowed to convey collected data straight to the BS. CHs, which are positioned in 3rd, 4th and other outer rings, are not allowed to transfer data to the sink. CHs of the outer rings can send data only to the cluster heads of inner rings (1st and 2nd rings). As the nodes in the inner rings have more initial power than nodes in the outer rings, power of nodes in inner rings will not deplete soon.

Authors in [8] have proposed CLUE-HOPE, a clustering based energy holes prevention mechanism. Here, a cluster can adjust its size by taking cluster members from its own and/or from neighboring grids. It achieves even energy consumption among motes by revolving the role of CH amid the motes. Further, a GCCR technique was anticipated, which joins many clusters through gateways in a desirous way and transmits the sensory packets to the BS. The CLUE-HOPE also uses the S-MAC [9], DSSS (direct-sequence spread spectrum) and RS coded through a M-FSK method to increase routing enactment. Every sensor decreases the possibility of data retransmission by an operative fault recognition process at the physical layer.

Unequal clustering also proved a good solution to the holes issue. The authors in [10] have suggested that the CH near to the sink are saddled with denser forwarding traffic and have tendency to exhaust very quicker, causing the holes issue and sensor-net division. Using an uneven radius of clusters and swing among inactivity and activity of the nodes is the basic idea. The cluster radius is determined theoretically, for the maximal lifespan of the network. It has been concluded that the lifespan of the network with clustering is 2/3 times more than lifetime using direct data transmission. To deal the problem of energy holes, cluster heads (CHs) nearer to the sink have lesser dimensions than those long away from the sink, consequently heads nearer to the sink can sustain certain power for the inter-cluster information progressing.

Soro et al. [11] have also projected the idea of non-uniform clustering to lengthen the lifespan of the sensor-net. The researchers have suggested that generally, all CHs spend their power on cluster communiqué. In the intra-cluster communication, energy consumption varies consistently as the number of sensors inside cluster changes, while in case of inter-cluster communication the power depletion relies on the estimated burden from the clusters long away. Consequently, the uniform power depletion can be achieved by altering the number of sensors in all clusters with regard to the estimated forwarding traffic.

The EEUC[12] protocol, has suggested that clusters nearer to the BS are likely to have lesser cluster radius, therefore clusters must spend lesser power throughout the intra-cluster data handling, and may reserve certain extra power for the inter-cluster forward load. However, it has a shortcoming that a CH picks a relay sensor from its nearby CHs without reflecting the relay load balances. Relay load balancing has been considered in the EEDUC protocol [13]. Here, hotpot problem has been solved by contemplating the number of neighbor's sensor mote and the remaining power of each sensor.

The authors in [14], have provided an in-depth theoretic investigation of the energy hole and lifetime in cluster centered sensor-nets. They have determined the exact location of energy holes, exact duration and time of occurrence of the hot spot problem. Figure 2 illustrates clustering instance in WSN [19].

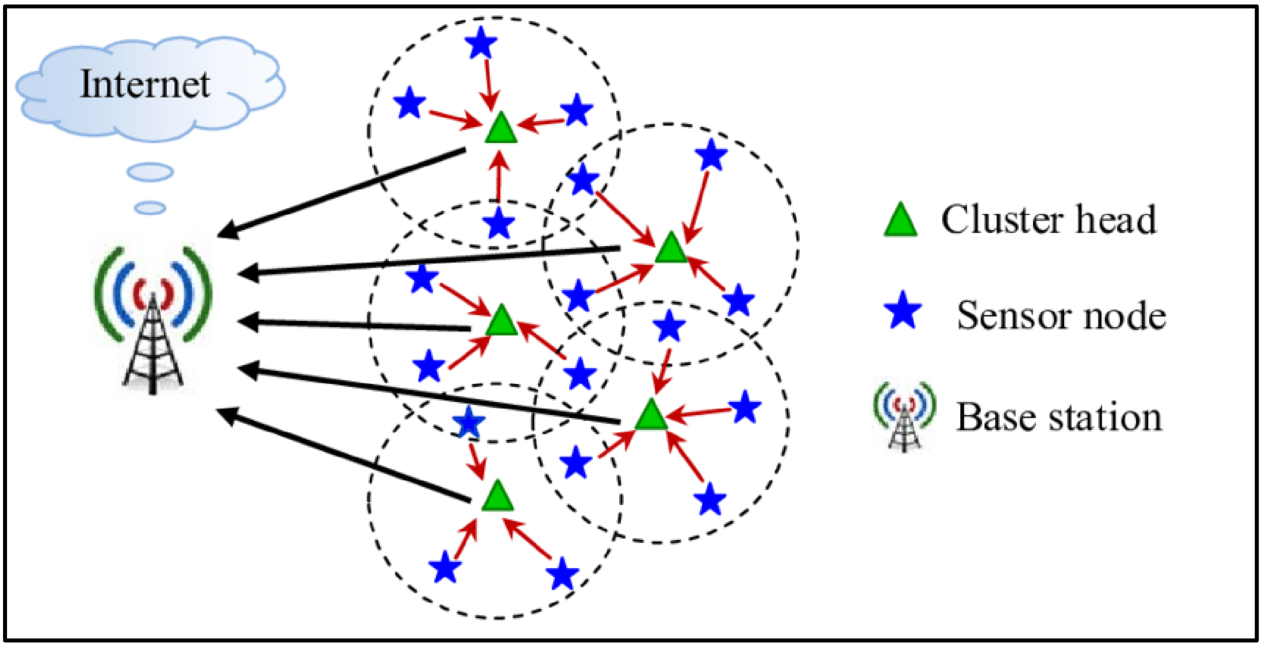

Fig 2: Clustering Mechanism in WSN

Gateways Based Method

To support uniform power depletion through the WSN, few nodes might be set as the gateway. These nodes support multi-node transmission and reduce the load of data transmission from the normal sensor nodes.

Rasheed et al. have recommended the energy aware M-GEAR protocol [15]. The area was portioned into four logical sections and placed one gateway node at the mid of the region. The base station is placed outside of the monitored area. If the distance of a node from the gateway or the BS is lesser than a specific distance value, the sensors follow the straight message. The reaming region has been divided into two parts and CHs were picked in these two parts.

The authors in [16] have used a certain number of gateway nodes at the border of the region. The BS is positioned external of the field of interest. All the cluster head nodes communicate to the BS through gateways. Further, they have used the SEP protocol [17] for a heterogeneous environment in the network. Some sensor nodes have extra energy than other nodes. The sensors with extra power are probably chosen as the CH nodes. A cluster head communicates with its nearest gateway node. The chief advantage of the method is that, if any, of the gateway node fails, its nearby gateway node starts communicating with CHs from the region of the failed gateway node. In a larger area, the number of nodes will remain inadequate and in a small area, the number of nodes will become surplus. Fig 3 provides a combination of region based; gateway based clustering management of WSN [18].

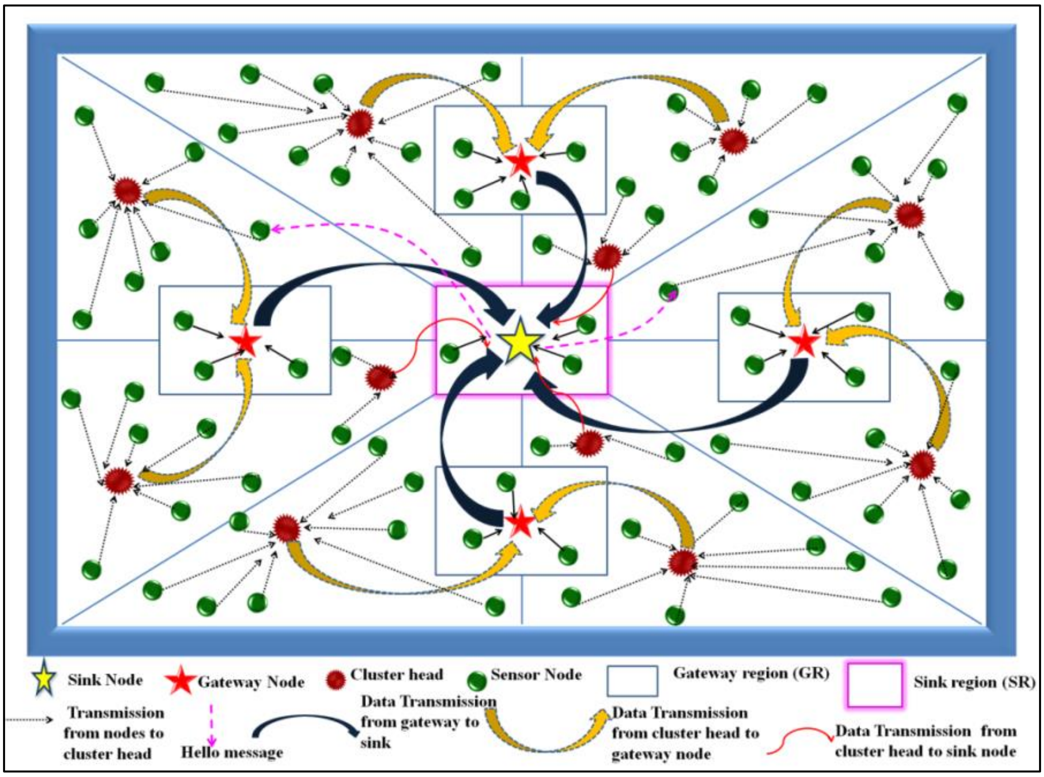

Fig 3: Gateway Based Distribution of Nodes in WSN

REGION BASED PROTOCOLS

Zone Routing Protocol (ZRP)

One of the most well-known hybrid routing protocols is ZRP [20]. It's a well-known ad hoc system that blends proactive and reactive routing. In this case, the proactive technique is used inside the confines of the indigenous locality or route zone. IARP, IERP, and the Border-cast Resolution Protocol have all been combined into this protocol (BRP). It contains a variety of Query Control techniques. The IARP's scope is constrained by the zone's radius. The IARP efficiently maintains the topology information of its local zone within the radius of this routing zone. The IERP serves as a global routing component for ZRP. If a sensor convey data outside of the routing zone, or if the path requested by the sensor does not exist in the sensor's original area, IERP can help. The IERP performs path searching and preservation in the same way that reactive routing systems do. To reduce routing overhead, the BRP Protocol is employed. The outside request is multicast by default, and it is transmitted to a defined group of neighbouring nodes. If no signal is received after BRP, this group of nodes will perform border-casting towards their neighbouring nodes.

The authors of [21] created a ZRP and clustering-based routing protocol to solve the WSN's energy hole problem. They presented a ZBRP for WSNs based on two key methods: clustering and network model area. The main purpose of ZBRP is to increase the WSN's lifespan by reducing whole-power depletion and limiting the control cost on sensors in the setup. By using sensor position information, the ZBRP creates clusters of uniform size with the least amount of control cost. Every data transmitting cycle of the network zone uses arbitrary back track clocks to select CHs. ZBRP achieves energy hole less WSN with consistent power depletion among the CHs using a regular and precise multi-hop data transmission system. To form clusters in the WSN, the ZBRP combines the benefits of similar and dissimilar clustering approaches. Its major goal is to increase the network's lifetime by lowering control overhead and minimizing the network's total power depletion. The authors hypothesized that the network's BS is equipped with an energy-regulated ability directional antenna. By varying its broadcast energy level in different directions, this antenna provides position ID for all sensors in the network. The sensors are grouped into hierarchical clusters using these characters, excluding the sensors from the starting circle. This arrangement was developed to avoid relay traffic weight on the CH of the initial circle, and the sensors from this circle communicate directly to the sink node.

A ZEMDC for WSNs has been proposed by the authors in [22]. The main goal of the upcoming ZEMDC is to extend the life of the sensor network by balancing the power. The detected data from all sensors is sent to the BS using the multi-hop approach, which is accomplished by determining the optimal hop distance for selecting the midway relay sensor. Sensors transmit data across the shortest possible hop distance, resulting in consistent power release across all sensors. In order to collect data, the Mobile Data Collector navigates to each zone head and significantly extends the sensor-lifespan net's as compared to prior efforts.

The ZBEEC protocol for WSNs was proposed by the authors in [23]. Clustering has been divided into two categories: fixed and dynamic, based on the orderliness of clustering, which can be even or uneven depending on cluster dimensions or sensor count. Energy holes are produced in classified routing systems due to imbalanced power depletion among the sensors during multi-hop transmission.

Unequal dynamic clustering is used to tackle the problem of energy holes, although it does not guarantee connectivity and has a high overhead. The authors proposed a zone-based power-efficient clustering routing protocol to reduce overhead, ensure connectivity, and reduce the problem of energy holes. The target zone was divided into an even number of stationary clusters. The clusters are divided into two zones: close and far away zones. The zone closest to the BS is the nearby zone, while the rest of the network is in the far zone.

In the surrounding zone, twin CHs are used to distribute receiving, aggregating, and data acceleration activities. The CHs are chosen based on their distance from the BS, remaining power, and distinctive qualities. For data transfer, a power-efficient inter-cluster transmission has been used, with the remaining power and distance to the BS being taken into account. The proposed approach avoids the formation of energy holes, employs unbiased power depletion among the sensors, and extends the sensor's lifespan.

Throughout the studies, the number of clusters and CHs remains constant. The creation of zones and their subdivision into subzones balances network traffic throughout the whole network. The CHS and member sensors use stable power depletion as part of the protocol. The use of twin CHs in nearby zones prevents energy holes from forming. The CHs are optimally chosen based on remaining power, singularity, and distance to the BS.

Conclusion

This section finally concludes that all our proposed mechanisms and protocols established a uniform consumption of energy in the network. This work conserve energy, avoid energy holes issue and increase the lifespan of the network. Moreover, these methods provide a good throughput and stability period to the network. The information produced by the sensor network is more reliable in the occurrence of these protocols, as there is enough enduring power existing in the network and an adequate number of CHs (in event of clustering-based protocols) are available per round in the network. Additionally, the comparative investigation of the proposed protocols with prevailing protocols, theorems as well as simulation results have proved the true validation of the authenticity of the research work carried out in this thesis.

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