Energy Efficiency in Wireless Sensor Network: A Comprehensive Survey

Shital Yadavrao Gaikwad[1], Dr. B. R. Bombade[2]
[1]*Research Scholar, Dept. of Computer Science and Engineering, Shri Guru Govind Singhji Institute of Engineering & Technology, Nanded, Maharashtra*
[2]*Research supervisor, Dept. of Computer Science and Engineering, Shri Guru Govind Singhji Institute of Engineering & Technology, Nanded, Maharashtra*

Abstract **- Wireless Sensor Network applications supporting diverse fields have gained a vital focus and interest from the researchers these days. WSN applications are designed to support scalable real time environment monitoring that depends on region of implication. The major challenges in WSN include energy optimization, routing, obstacle identification, security, etc. These constraints need prioritized optimization in fulfilling the requirements of the deployed environment. The sensing coverage of a sensor node is the area determined by the sensing range of the sensor node. Sensing coverage of the network is the collective coverage of the sensor nodes in a WSN. Sufficient number of sensor nodes need to be deployed to ensure adequate coverage of a region. Further, since sensor nodes have limited battery life, it is also essential to reduce the energy consumption. This would help improve the network lifetime and thus the coverage lifetime. To reduce energy consumption in the WSN, some of the nodes with overlapping sensing areas could be turned off using a coverage optimization protocol. In this paper, we discuss various coverage optimization protocols and routing along with energy efficiency techniques for wireless sensor network. We are describing various authors review on proposed techniques for energy efficiency techniques for optimization of wireless sensor network.**

Index Terms **- Apriori, Improved Apriori, Frequent item-set, Support, Candidate item-set, Time consuming, Regression**

I.INTRODUCTION

The basic idea of anytime and anywhere computing leads to the new field called mobile computing. The advances in the wireless technology are also one of the major stimuli for the growth of mobile computing. But here in this ubiquitous computing environment we cannot follow the normal architecture and protocols which have been used in the fixed network due to its battery powered devices involved in the computing and transmission of the data. The advancement in these miniature computing model and wireless transmission techniques lead to the development of the wireless sensor networks. Sensor networks are needed in the applications like environment monitoring, industrial control units, military applications and in the context aware computing environments. The simple flooding type routing protocols will be coming under the direct approach. Though it is simple in its implementation, it is not an energy efficient protocol for the sensor networks. In the Location based routing the base station communicates with sensor nodes based on its location identity. Here all the nodes are aware of its location through GPS (Global Positioning System) receivers in the network. In WSN instead of collecting information from all the nodes the application needs the data only from the nodes which satisfies its interest and this information gathering technique is widely called as the data centric approach or attribute-based routing. Direct diffusion and rumor routing are the best examples for the attribute-based routing or data centric approach.

These days Wireless Sensor Networks (WSN) have been used in various Internet of Things (IoT) applications viz., healthcare monitoring, disaster management, smart buildings, smart farming etc. it is one of the substitutes for solving distinct problems of IoT in various areas. Power efficiency is one of the major issues with sensor networks. In the earlier days, WSN was working on Client Server (CS) model, but for the improvement of energy efficiency, researchers proposed Mobile Agent (MA) based WSN. In today's era the Wireless plays a great role for the society because as we are in 21st century so to minimize the

need of labour and manpower the human being started using the wireless sensor-based devices. But in all those devices the need for life of battery is of great concern. So, the dissertation consists of a Joint Cluster Routing algorithm for improving the network lifetime.

II. ORIGIN OF WIRELESS SENSOR NETWORK

WSN is an association of compact micro sensors with wireless communication capabilities. Like many advance technologies, WSN owe its root in heavy industrial applications as well as military applications. The first wireless network that is in-line with the latest WSN is the Sound Surveillance System (SOSUS) developed on submerged acoustic sensors. Sensors in SOSUS were distributed in the Pacific Ocean Atlantic oceans.

Stimulated by the developments pertaining to Internet in 1960s and 1970s to develop the hardware for today's Internet, Defense Advanced Research Projects Agency (DARPA) initiated the Network (DSN) program in 1980[21]. The motive was to explore the design challenges related to WSN. With the birth of DSN and its penetration into education through Carnegie Mellon University and the Massachusetts Institute of Technology, WSN technology could find its base in household, education and civilian scientific research.

Very soon, public and private communities started deploying sensors to monitor air quality, detect forest fire, forecast weather, prevent natural disaster etc. The sensors however at that time were bulky, expensive, and made use of proprietary protocols. The use of such WSNs thus weighed down the industry which used it. This disproportionate relation of high cost with low volume of sensors declined their pervasive use.

IV.CHALLENGES IN DESIGNING OF WIRELESS SENSOR NETWORK

A major issue in designing of wireless sensor network is of energy limitation. As sensor networks are usually placed in areas which are harder to reach, it is difficult to replace them or recharge their batteries. The network lifetime is directly dependent on energy efficiency.

Therefore, design of reliable and efficient sensor nodes and routing protocol is a major design challenge. A sensor node consumes energy for sensing analog data, processing the data and transmitting the data.

Another issue is designing of application-specific wireless sensor network setup for different tasks may need to sense different type of data.

III. WIRLESS SENSOR NETWORK

WSN is a group of spatially distributed sensors meant for measuring various physical parameters like sounds, pressure, temperature, and chemical composition etc. In WSN each node is connected to one sensor. In 21st century WSNs has become very vital in human being daily life. This technology is growing at a very rapid rate the craze is increasing day by day, with the help of WSNs we can collect data from anywhere and at any time thus it helps in saving time money and labor cost.

Sensor Node:

Sensors are small, less power and low-cost devices that communicate within the minimum distance through radio frequency. The sensor node is defined as an electronic device which aims to detect events or changes in its environments. Each sensor node comprises of low powered battery, microcontroller, transceiver, receiver and an external memory for storage purpose. The low powered batteries of sensor node have a vital role in WSN. The reason behind it is that the life of WSN stays until there is a battery in sensor nodes. Thus, preserving the battery of sensor nodes is one of an essential challenge in WSN. More the energy consumed, more the power of battery is required and thus reduction in energy consumption is a vital factor for enhancing network lifetime.

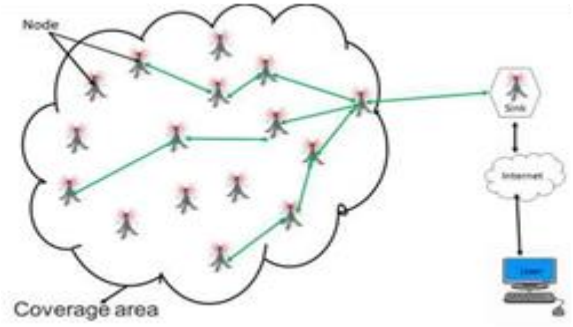

FIG 1.0 WIRELESS SENSOR NETWORK.

IV. LIMITATION OF SENSOR NODE

- The limitations of a wireless sensor node are as:
- Sensing ability
- Associated with battery power
- Limited memory
- Lack of processing power

V. DESIGN ISSUES IN WIRELESS SENSOR NETWORK.

Regardless of plenty of utilizations of WSNs, the systems have a few limitations, e.g., restricted computing capability, constrained vitality supply, and restricted data transfer capacity of the remote connections interfacing SN. The primary plan objective of WSN is to do data communication together with the enhancement of systems lifetime and not allowing connectivity to degrade by using efficient energy administration methods.

- Node deployment stage in WSN impacts the execution of the routing protocols.
- Reduction in Energy consumption
- The network should be fault tolerant i.e. the death of sensor nodes due to any reason such as battery loss etc. should not affect the working of the entire network.
- Node Heterogeneity.
- Fault Tolerance.
- Delay in packet delivery in wireless sensor network.

VI RELATED WORK

Attahiru S. Alfa, at.el [01] In this paper, we provide a clear picture of both the energy-efficient and energy-balanced routing protocols for WSNs. More importantly, this paper presents an extensive survey of the different state-of-the-art energy-efficient and energy-balanced routing protocols. A taxonomy is introduced in this paper to classify the surveyed energy-efficient and energy-balanced routing protocols based on their proposed mode of communication towards the base station (BS). In addition, we classified these routing protocols based on the solution types or algorithms, and the input decision variables defined in the routing algorithm. The strengths and weaknesses of the choice of the decision variables used in the design of these energy-efficient and energy-balanced routing protocols are emphasized.

B. Baranidharan at, el [02] This paper gives an overview of the different routing strategies used in wireless sensor networks and gives a brief working model of energy efficient routing protocols in WSN. We have also compared these different routing protocols based on metrics such as mobility support, stability, overlapping. The study concludes with the recommendations to the future direction in the energy efficiency model for the sensor networks.

Kye San Lee,at.el [03] In this paper, recent developments in techniques for designing highly energy-efficient and QoS-capable WMSNs are surveyed. We first study the unique characteristics and the relevantly imposed requirements of WMSNs. For each requirement we also summarize their existing solutions. Then we review recent research efforts on energy-efficient and QoS-aware communication protocols, including MAC protocols, with a focus on their prioritization and service differentiation mechanisms and disjoint multipath routing protocols.

Maya M.Warrier, at .el [04] This paper provides a survey on energy efficient routing. A comparison between Modified LEACH and Mobile Sink improved energy-efficient PEGASIS-based routing protocol is done using MATLAB. Paper also introduces the energy harvesting concept.

F.Bajaber, I.awan,at,el [05] Thus the existing routing strategies in the wireless sensor networks and their corresponding protocols had been explained. Though the protocol like LEACH, HEED, DECA, SPIN, and PEGASIS are proved to be energy efficient than its previous models the main pitfalls in these protocols are that nodes are assumed to be static and stationary. The energy efficiency model is untested while the sensor nodes exhibit mobility. Future works may concentrate on achieving better energy efficiency in routing mechanism for mobile wireless sensor nodes.

O. Younis, S. Fahmy,at.el [06] The existing energy efficiency model for the sensor network shows considerable improvement in one or more objectives to suite the specific application, still there needs a lot of work to be done on energy efficient model in terms of low clustering overhead, distributed cluster heads, continuous packet delivery, reduced data fusion cost. In this paper we are proposing a new hybrid protocol

model which considers all these factors in the routing mechanism for the wireless sensor network. The following are the steps involved for the proposed hybrid model

S. Lindsey, C. Raghavendra, at.el [07] Though the Cluster based protocols like LEACH have shown a factor of 8 improvements when compared with its previous protocols further improvements were done by forwarding the packets to only one neighbor of the node. This method had been named as „Power Efficient Gathering in Sensor Information System"[7]. Instead of forwarding the packets from many cluster heads as like in LEACH protocol here in PEGASIS each node will form a chain structure to the base station through which the data would be forwarded to the BS node. Here in PEGASIS energy efficient is achieved by transmitting the data to only one of its neighbor node.

W.B. Heinzelman,at.el [08] The first type of data aggrgration fuses the data gathered from different sources and sends the final fused data in reduced size. But the problem behind this approach is it lacks in accuracy and precision of data from various sensor nodes. The second approach combines the data from different sources under the the single header and forward it to the base station. Here header packets consolidates and pass it to the base station without any modification to the original data from the sensors. Hence accuracy is improved.

.E .Kranakis, H.Singh and J.Urrutis.at.el [09] this paper propsed the leach . Low energy adaptive clustering hierarchy[9] uses the clustering principle to distribute the energy consumption all along its network. Here, based on data collection, network is divided into Clusters and Cluster heads are elected randomly. The cluster head collects the information from the nodes which are coming under its cluster. Let us see the steps involved in each round in the LEACH protocol.

P.Bose and P.morin.at.el [10] The modified version of greedy-face-greedy algorithm is the Greedy perimeter stateless routing[14]. Here the combination of greedy and perimeter approach is taken. Initially the data is forwarded by using greedy approach and if the packet gets stuck at any point, perimeter approach comes to rescue of the situation. But this perimeter approach is followed till a node closer to the destination was found than the node at which the packet got stuck. It ensures the guaranteed delivery of packets to the destination.

I. Stojmenovic and X. Lin,at.el [11] The routing of data to the nodes is done by the geographic location of the nodes (i.e.) nodes are identified by its location only. The location information of the individual nodes is obtained by the low power GPS receivers embedded in the nodes. Some of the most important protocols coming under the „Location based routing" strategy are Greedy approach Compass routing DREAM GPSR GEAR.

Y. Xu, J. Heidemann, D. Estrin, at.el [12] stated that the source node S calculates the direction of the destination D and the neighboring node Y which is having closest direction to the destination than SD is selected as the next eligible intermediate node to route the data from the source node.

Y. Yu, D. Estrin, and R. Govindan,at.el [13] This paper focuses in surveying preceding optimization techniques under multi-objective perspective that results in tradeoffs. We exclude the familiar optimization approaches and analyze distinct metric specific optimizations based on link failure, load balancing and distance.

Z.Kranakis, H.Singh and J.Urrutis.at.el [14] This paper performs SLR for energy efficiency routing Initially, we present literature that includes schemes for threshold sensitive, adaptive periodic threshold sensitive, power efficient, hybrid energy efficient distribution and low energy adaptive mechanisms. Result of systematic review reveals that consumption of energy is the most fundamental issue in WSN however, is not noticed by the researchers and practitioners whereas it can contribute for the improvement of the energy efficiency. It also elaborates the weaknesses of the existing approaches which make them inappropriate for energy efficient routing in WSN.

CONCLUSION

The availability of sensor devices allows a wide variety of applications to emerge. However, the

resource constrained nature of sensors raises the problem of energy: how to maximize.
network lifetime despite a very limited energy budget? In this paper, we have summarized different techniques that tackle the energy efficiency challenge in WSNs and classified them in five main classes as shown in Figure 1 that summarizes this survey. For each class of techniques, we have pointed out which source of energy waste it alleviates.
The availability of sensor devices allows a wide variety of applications to emerge. However, the resource constrained nature of sensors raises the problem of energy: how to maximize network lifetime despite a very limited energy budget in this paper, we have summarized different techniques that tackle the energy efficiency challenge in WSNs and classified them in various author review that summarizes this survey. For each technique, we have pointed out which source of energy waste it alleviates.
In this paper we have represented the various methods of wireless sensor network using protocols, routing, delay, load, average, deployment of node, fault tolerance preservation. This paper presents various systematic literature review on energy efficiency enhanced in wireless sensor network. Energy efficiency is one of the major issues in sensor networks. Various approaches have been proposed for solving this issue. Some methods are agent based while others are non-agent based. Agent based algorithms are further divided into types. In this paper, a brief survey on energy efficient algorithms is presented. The future advancement of the work can be more advancement can be done in the proposed method so that network lifetime by using different more approaches.

FUTURE SCOPES

In future will study the JCR protocol for dynamic networks such as ad hoc wireless networks. To overcome the problem of Stagnation and congestion by using Multiple optimizations of mobile agent node. In the improved version, we will find more than one optimal outgoing interfaces are identified as compared to only one path, which are supposed to provide higher throughput and will be able to explore new and better paths even if the network topologies get changed very frequently. This will distribute the traffic of overloaded link to other preferred links. Hence the throughput of the network will be improved, and the problem of stagnation will be rectified. So, this methodology used in future work.

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