International Organization of Research & Development (IORD)
ISSN: 2348-0831
Vol 02 Issue 02 | 2015

Review of Lifetime Enhancement of Wireless Sensor Networks

Mrunal V. Funde, Dr. M. A.Gaikwad, Prof. A.W. Hinganikar
E & T Engineering, BDCE, Sevagram.

ABSTRACT

In this paper we have studied few technologies related to the lifetime enhancement of wireless sensor network. The lifetime of wireless sensor network is a critical factor that needs to be addressed by considering different parameters that affect the lifetime of wireless sensor network. The lifetime of the WSN mostly depends on energy consumption by node.

The enhancement of network lifetime is carried out by considering different parameters including duty cycle management, network coding, cluster head selection, routing and selection of topology. Each method has its advantages and disadvantages. In the duty cycle management approach the energy efficiency of network increases but there is no provision for packet latency. In network coding approach packet latency is considered but efficient routing algorithm is not introduced. This leads us to couple the advantages of various methods for lifetime optimization and provide an efficient solution for lifetime optimization.

Index Terms—**Cluster Head , Energy efficiency, Routing, Wireless Sensor Network.**

I. INTRODUCTION

Wireless sensor network (WSN) has great advantages in day to day life i.e. it is widely used in the commercial and industrial areas such as environmental monitoring, healthcare, process monitoring and surveillance. The WSN is the network which consist the small devices known as nodes. The nodes are consisting of CPU, memory, battery and transceiver [10].The operation of WSN depends on the parameters like network lifetime, topology of the network, weather conditions, type of the node and zone around the sink node. In our proposed work we are concentrating on the WSN lifetime. The lifetime of the WSN depends on the battery life, energy consumption by nodes and packet loss. These parameters can be controlled by different approaches like duty cycle management, Network coding, topology management, routing algorithms. In our proposed work we are going to implement the duty cycle management approach and introducing other approaches including network coding and cluster head selection.

The limited battery lifetime of nodes also affects the overall lifetime of WSN. The heavy traffic on the sensor nodes near the sink also has the effect on the network lifetime [1]. If we switch the node in the sleep and active mode then it leads to the energy saving of the node. The concept of switching the node in active and sleep mode can be achieved with the help of duty cycle. The duty cycle is nothing but the ratio of active time of the node to its total time. With the help of the duty cycle the nodes can be activated whenever it wants to transmit the data to the sink otherwise it will be in sleep mode and if the node is in sleep mode then the energy consumption is automatically reduced.

At the time of transferring the data there may be the loss of packets or the problem that the original packet may not be received at sink can arise, this ambiguity can be solved by the network coding technique. The network coding is the technique which allows the intermediate node to encode the data and transfer it to the next node and at the receiver node the original data will be decoded. That approach of network coding gives us the reliability of transferring the original data at the better packet delivery ratio. If the unwanted data packets are neglected then obviously the energy consumption also reduces and it leads to lifetime enhancement of WSN.

The data transferred with routing algorithm is the efficient way. There is number of routing algorithms available, but the cluster head selection algorithm it will be more efficient. In cluster head selection method one of the nodes from a cluster is selected as the cluster head and that will be used to gather the data from the neighboring node and transfer it to the base station or sink node [4]. The cluster head will be selected on the basis of residual energy and lowest mobility factor. This approach provides better routing algorithm. The better routing for communication then leads to lifetime optimization. In our proposed work we are using cluster head selection algorithm, duty cycle management and the network coding approach together for better results.

II. LITERATURE REVIEW

This section briefly outlines the related works carried out by researchers in the area of lifetime enhancement of WSN.

Duty cycle is used to reduce the energy consumption in the WSN. Rashmi Ranjan Rout et al. [1] have derived the combination of duty cycle and network coding for lifetime enhancement. In this work they achieved the good energy efficiency and good packet delivery ratio. But it does not elaborate on the routing algorithms. Also the multi-hop communication is not considered.

Low – power- listening MAC protocol, AADCC and DDCC approaches used for duty cycle controlling by Christophe J. Merlin et al. [2]. Both the approaches lead to less energy consumption but AADCC gives better result than the DDCC. Here the low energy consumption is achieved but has the disadvantage of packet loss and due to the packet loss the data communication gets affected.

Heejung Byun el al. [3] proposed Adaptive Duty Cycle Control with Queue Management in WSN. Here the queue management of the duty cycle is only considered, so this work only concentrates on duty cycle. The energy efficient WSN is achieved but due to the queue management the end to end delay is increased and has the disadvantages of packet delivery ratio due to packet loss.

Qinghua Wang, and Tingting Zhang [4] proposed Bottleneck zone analysis in Energy-constrained wireless sensor network. This work concentrates on the bottleneck zone which is around the sink node. They work out for lowering the traffic in this zone. Therefore as the traffic is minimised the collisions between the data packets are minimised and the energy consumption gets reduced.

The network coding was introduced by Ahlswede et al. [5] in the field of information network. They introduced this method for the better and efficient communication. The network coding has two phases i.e. encoding and decoding. The encoding is done at intermediate node and decoding is done at the receiver node. Because of the encoding and decoding approach, the transmission of original data to the sink is efficiently done. Here the packet delivery ratio is achieved but energy efficiency is not achieved.

Lun et al. [6] proposed The network coding based approach that improves the packet level capacity of the network. This work implements only network coding approach for efficient packet delivery. In this work they introduced the packet capacity, but do not have any routing scheme for better transmission. Therefore the energy consumed by the network may increase for transmitting the data along the unknown way. The network coding based routing scheme is presented by Rout et al [7]. In this work the routing algorithm is derived for the efficient transfer of the data packet. Therefore the unwanted energy consumption is reduced by introducing the routing algorithm. But in both the above work there is no provision for energy conservation of the node.

The cluster head selection is also available for the energy efficient WSN. The work done by Do-Seong Kim and Yeong- Jee Chung propose LEACH-Mobile [9] (LEACH-M) concentrates on routing protocol which is applicable to Wireless mobile networks. But in this protocol, transmission overhead is increased to send a message because of membership declaration. To move forward this problem, Santhosh Kumar G et al. propose LEACH-Mobile-Enhanced [10] (LEACH-ME), the node with a lowest mobility factor is selected as a CH. But LEACH-ME consumes more energy for determining mobility factor of the each node and this affects the lifetime of the WSN.

There is also work done by R.U. Anitha et al. [11] for energy efficient cluster head selection algorithm in mobile WSN. Here they introduced the energy efficient method for the selection of cluster head, so they achieved the energy efficiency but the packet delivery ratio is not achieved.

As the cluster head provides the better routing algorithm but does not provide better energy efficient algorithm because all nodes are active throughout the operation, therefore the nodes losses the energy at that time.

III. PROPOSED METHODOLOGY

The objectives of our proposed work are

i) To minimize Energy consumption.
ii) To improve Packet delivery.
iii) To improve Throughput.

Our proposed work will be done in the three phases. In the first phase all nodes around the sink in WSN are divided into small clusters. Clusters will be formed by the Base station (BS). During the first round, the base

station first splits the network into two sub clusters, and proceeds further by splitting the sub clusters into smaller clusters [11] as shown in fig.1.

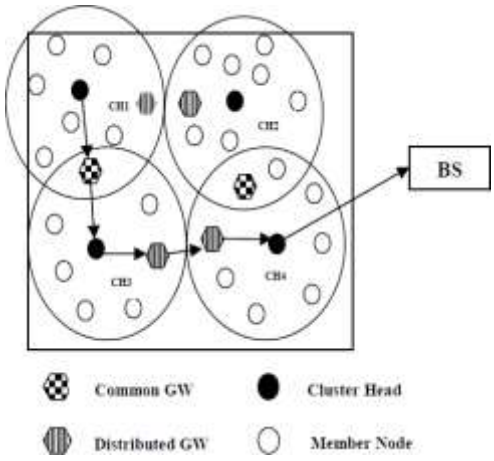

Fig.1. Data transmission from CH to the base station.

In the next phase the cluster head selection will be done on the basis of residual energy and mobility factor. After the selection of cluster head, now the scheduling will be assigned to the neighboring nodes. On the basis of that scheduling the duty cycle will also be assigned to the nodes. On the basis of the assigned duty cycle that node will only get activated whenever it transmits the data otherwise it will be in sleep mode.

The next phase is for the communication i.e. for transferring the data packet from CH to the base station as shown in fig.1, for this purpose the better routing algorithm will be assigned. The data is now ready to transfer to the sink. Since we are using the network coding approach, before transferring the data towards the sink it has to be encoded by the intermediate node. After receiving the data at receiver the original packet has to be decoded.

The same process mentioned in different phases above will be carried out in the next cycle of data transfer. The cluster formation, routing and data transmission is shown in fig. 1.

IV. CONCLUSION

The operation of WSN is depends on the network lifetime. In this paper we have study some of the technologies discussed for lifetime enhancement of WSN by different researchers. Some of them implement duty cycle concept for energy efficiency and network coding concept for packet delivery. Few of them implement queue management, but due to end-to-end delay the packet delivery ratio does not achieved. Routing schemes are also used for better transmission by the researchers.

Different researchers achieve different parameters of lifetime. We will try to achieve the minimum energy consumption, good packet delivery and improved throughput by implementing different schemes together.

Therefore in our proposed work, we are proposing the technique to enhance the lifetime of WSN using Duty cycle, network coding and cluster head selection algorithm together to achieve minimum energy consumption, improved packet delivery ratio and improved throughput.

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AUTHOR BIOGRAPHY

Mrunal V. Funde, MTech (IVth) B.D.C.E, mrunalfunde007@gmail.com.

Dr. M.A.Gaikwad, M.Tech, MBA, MCM, PhD, Principal, **B.D.C.E**, gaikma@rediffmail.com

Prof. A.W. Hinganikar. M.Tech(Electronics),B.D.C.E. (E&TC Department),
anant_hinganikar@rediffmail.com