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Techniques of optimizing lifetime and reduction in power consumption in wireless sensor network- A survey

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ABSTRACT

Due to congenital restriction of sensors, it is always a crucial issue on how to utilize limited energy effectively. In wireless sensor network(WSN's), the long lifetime requirement of different applications and limited energy storage capability of the sensor nodes has led us to find out new horizons for reducing power consumption upon nodes. To increase sensor node's lifetime, circuits and protocols have to be energy efficient so that they can make priori reactions by estimating and predicting energy consumption. The goal of this paper is to have survey of various techniques which can be used to optimize lifetime and power consumption in case of wireless sensor networks.

Keywords: Wireless sensor network, Timing constraints, network lifetime, Bacterial Foraging Optimizing Algorithm (BFOA),

I. INTRODUCTION

A wireless sensor network consists of sensor nodes deployed over a geographical area for monitoring physical phenomenon like temperature, humidity, vibration, seismic events and so on [1].It consists of sensor nodes capable of collecting information from the environment and communicating each other with transceivers. The collected information will be delivered to one or more sinks, generally via multi- hop communication. The sensor nodes are typically expected to operate with batteries and are often deployed to not- easily accessible or hostile environment, sometimes in large quantities. It can be difficult or impossible to replace the batteries of the sensor nodes. On the other hand, the sink is typically rich in energy. Since the sensor energy is the most precious resource in WSN, efficient utilization of the energy is the most precious resource in WSN, efficient utilization of the energy to prolong the network lifetime has been focus of most of the research on the WSN. [2]

Power consumption evaluation of Wireless sensor network can be evaluated by many methods. One way is to carry out the evaluation directly based on physical hardware, by periodically measuring the remaining battery. This process, however has several problems such as need of high financial investment, reproducibility of the environment, inherent dynamism, complexity and size of WSN's and potential impact of hardware and human failures. [3]

Another way for conducting the power consumption of WSN application through modelling. Although modelling may provide less accurate results than measuring, it provides the designer with the flexibility and agility to evaluate complex scenarios without interfering on the actual environment.[4]

The systematic architecture plays an important role in optimal energy consumption in wireless sensor networks. Sensor network consist of base stations and sensors. Base station serves as gateway to exchange data and control information with other networks. All the distributed sensor monitor and gather environmental data, and pass back the collected data to base stations for further processing. Clustering is very important concept on sensor network. Each cluster has a cluster head which collects and fuses data from its cluster members. The fused data will then be sent via multiple hop hierarchy to other clusters and then to other hierarchy. [5]

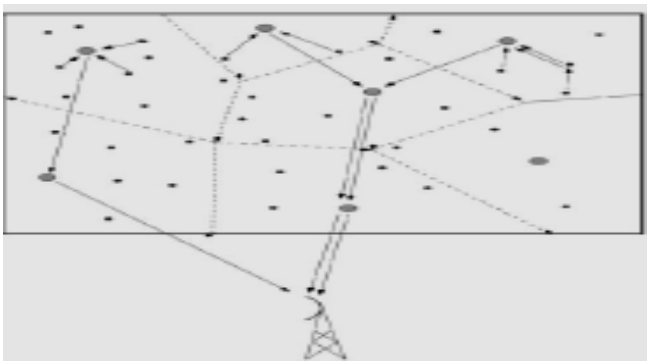

FIG.1 BASE STATION LINKS TO EACH CLUSTER HIERARCHY FROM NEAR TO FAR

Energy consumption can be lowered by the means of routing algorithm that consumes low energy. In[6], the number of clusters that should be formed for escalating the lifetime of a network with provisions made to include equal number of nodes in each cluster has been minimized. The analysis and simulation results show that with realistic radio model we have achieved better load balance than several existing protocols, like LBEERA, HDS, SHORT, PEGASIS, LEACH and BINARY. A suitable node deployment strategy was adopted for ensuring wireless connectivity between each node.

Factors serve as a guideline to design a protocol or algorithm. Some important factors pertaining to the WSN's are network topology, operating environment, hardware constraints, transmission media, power management , longevity, scalability, production cost and fault tolerance. Longevity deals with co-ordination of sensor activities and optimization of communication protocols. WSN's are constrained by limited resources of memory, computation power and energy. Energy can be treated as a cost function or a hard constraint [7].

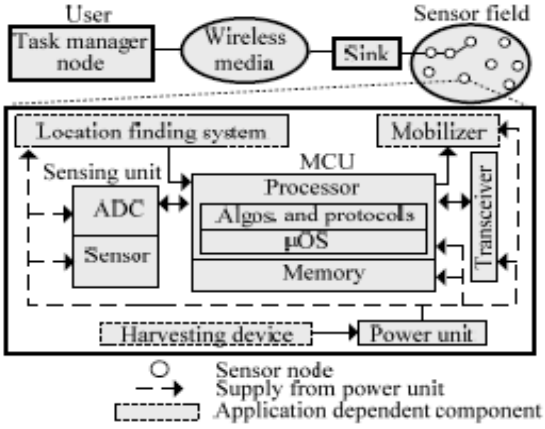

FIG. 2 WSN DESIGN AND ORGINIZATION OF COMPONENTS OF SENSOR NODES

In [8] LEACH Algorithm is presented, which randomly and periodically rotates the role of the cluster head over all existing nodes and ensures that all the nodes run out of their battery almost simultaneously. In this case very low remained energy is wasted at the expiration time of the system [9]. However, the disadvantage of applying cluster head role rotation is that all the nodes in the network must be able to act as cluster heads, and therefore should possess necessary hardware capabilities [10]. This method has some advantage as follows: a cluster head can reduce the number of redundant packets by aggregating data in the cluster [11]. By limiting the domain of the inter – cluster interactions to cluster heads, it maintains communication bandwidth [12]. Also this method can minimize the rate of energy consumption in nodes.

In [13] Bacterial Foraging Optimization [BFO] algorithm for cluster head selection is discussed. BFO is a population based numerical optimization algorithm. In recent years, bacterial foraging behaviour has provided rich source of solution in many engineering applications and computational model. It has been applied for solving practical engineering problems like optimal control [14]. It was shown BFO provides better performance than other popular techniques. However, the computational complexity of BFO for applicability to WSN's still remains a challenge.

In [15] a new approach to enhance PSNR of highly corrupted image affected by impulse noise was designed. The adaptive median filter is used to identify the pixels affected by noise and replace with median value to keep the information uncorrupted. The BFO technique minimizes error between adaptive median filter and output image and noisy image to maintain an error percentage of 0.0001.The results of proposed method are superior to conventional methods in terms of perpetual quality as well as clarity and smoothness in edge regions of resultant image. This method can also remove salt and pepper noise.

Cellular wireless communication is facilitated by Base Transceivers Stations (BTSs) which have appropriate spatial distribution. Cell planning is a fundamental and challenging part of network design process . The automatic techniques that lend a helping hand to locate the optimal number of cell sites in a specified area are indispensable due to non-uniform user locations and cell fluctuations.[16]

II. CONCLUSION

In this paper we have surveyed the techniques of optimizing the lifetime and reduction in power consumption in wireless sensor networks. Special attention has been devoted to a systematic and comprehensive classification of the solution proposed in the literature. We have not limited our discussion to the topics of the past which has received wide interest in past, but we have also discussed the various algorithm dealing with the optimal placement of the nodes to ensure minimum power consumption and optimizing lifetime.

The Bacterial Foraging Optimizing Algorithm is used to select the algorithm for selecting the best cluster head selection for WSN. The simulation results can enhance the performance of BFA based on total energy dissipation and number of alive nodes of the network when compared with other algorithms.

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