WEMER Energy-Efficient Protocol for Wireless Sensor Networks

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Abstract

The wireless sensor networks are decentralized and self-arranging network. In these networks, the information is sensed by the sensor nodes. The sensor nodes send this information to the sink. The energy consumption is a main concern in these networks. A routing protocol called WEMER is modified and implemented for increasing the life span of WSN in this study. The complete network is divided into clusters in this protocol and cluster heads are chosen within every cluster. The deployment of gateway nodes is done within the network for modifying the WEMER protocol. This is done to increase the lifetime of WSN. In the proposed improvement gateway nodes are deployed near to base station which takes data from the leader nodes. The cluster head gets data from the leader node. In this study, MATLAB software is used to implement the modified WEMER protocol and existing WEMER protocol. The proposed protocol contains smaller amount of inactive nodes, higher amount of active nodes, delivers higher amount of packets and has more residual power as per the obtained simulation results.

KEYWORDS: Energy Efficient, WEMER, WSN

Introduction

The current improvement in the technology of wireless sensor network leads to its immense use in various applications. These applications include automatic surveillance, traffic monitoring, harvesting, etc. These networks should be made more creative and productive for improving their usefulness. In last few years, a lot of analyzing techniques have been developed to perform information routing, data compression and network aggregation [1]. The data is transmitted by the sensor nodes using radio frequencies, infrared etc. These networks do not have any wired connection. The nodes are distributed randomly. The information is transmitted by these nodes. In the network, this process generates an ad-hoc arrangement. The major issue that occurs within WSN is the restricted amount of lifetime of a battery of nodes present within the network [2]. The sensor nodes face several issues due to their small dimension. These issues include limited battery, inadequate processors, and restricted memory. Therefore, the main aim is to decrease the power utilized by the nodes. The average time restraints are given in the network to transmit collected information to the destination such that it can be utilized prior to any hazard [3]. There is higher consumption of power due to the communication of data within these networks in comparison the processing occurring in these networks. Thus there is a need to address such issue. Node failure can occur due to the absence of power within these networks. A reliable service is to be provided within this network by keeping in mind the objective which is to be achieved. With the help of making adjustment, the network can act naturally as well here. From time to time, various adaptable properties are to be provided within this network [4]. Due to constrain provided in battery life, failure might occur within these nodes. In order to handle such failure and ensure that the operations are performed, the network protocols are to be provided within these networks. There is restricted lifetime of a battery provided within the normal nodes. They cannot be replaced easily as well due to which many problems arise. The scaling up of the sensor nodes within the network maybe done on the basis of architecture and protocol utilized within these networks. In case there is a method identified which can help in minimizing the measure of communication, the lifetime of the battery can be extended here [5]. By using low power components within the sensing subsystems, the energy consumption can also be minimized. Within these systems, the lifetime of a battery present can be maximized through the minimization of current or power of turning it off when it is not being utilized at all. On the basis of power of battery that has constrained energy, the sensor nodes of the wireless networks work on battery power. Re-clustering is important due to some sudden failure of nodes in the network [6]. Here, the remaining energy, and node degree might be required in such cases which can be provided by this method known as dynamic clustering. Various static parameters such as separation amongst the nodes are required in order to prepare the data. The reliability of the nodes is considered to be present here. In order to spare the

energy of battery, the clustering mechanism is required. The workload present on the cluster head is considered to be greater as compared to the non-cluster heads when clustering is utilized within these networks. In order to circulate the workload and energy consumption, the cluster heads of the clusters are changed which help in increasing the lifetime of the network [7]. Probabilistic (random or hybrid) clustering algorithms: Low Energy Adaptive Clustering Hierarchy (LEACH), Energy-Efficient Hierarchical Clustering (EEHC), Hybrid Energy-Efficient Distributed Clustering (HEED), etc. Non probabilistic clustering algorithms: Node Proximity and Graph-Based Clustering Protocols, Weight-Based Clustering Protocols, Biologically Inspired Clustering Approaches. The cluster head (CH) and cluster members can directly communicate with each other [8]. The existing CHs can be used to forward aggregate data to central base station by cluster head. The LEACH, and various modified versions of LEACH such as E- LEACH, LEACH-SM, multi-hop-LEACH, ENCM, etc are different techniques that are used in clustering. There LEACH protocol contains two stages. Radio Frequency Identification (RFID) can be defined as the radio frequency based communication less automatic identification capability. RFID has two energy sources. These sources are called active and passive. The passive source of RFID is more advantageous as compared to active RFID in terms of different factors.

Literature Review

Abdelbari Ben Yagouta, et.al (2017) presented a study for wireless sensor networks in which comparison between the sink at different locations and mobility patterns was performed. This examination was done to determine the impacts of mobility on energy consumption and QoS metrics. In the application of WSN, it improves the throughput even in the condition of high density and high packet rate [9]. It also increase the latency time of the packets as well as improve reliability but it does not increase the nodes density or the application rate of packets. There is no significant difference in the gain of energy. The energy consumed by the sink during communication is identified just 5% of the sensors weight. The growth in the density of nodes or packets rate causes hindrance and collision of data packets due to which there is decrease in packets latency time.

Jie Huang, et.al (2017) has analyzed and researched a multi-cluster-head based clustering routing algorithm. They studied this algorithm so that energy consumption rate in the wireless sensor network balances its rate. This method is also useful in extending the lifetime of the network and stability [10]. This paper discussed the model of energy consumption rate in wsn. For the multi-cluster-head based clustering routing algorithm, they studied the network topology and method for realization. Various simulation and scrutiny were performed on the multi-cluster-head based clustering routing algorithm. The obtained results demonstrated that the optimal equilibrium on power expenditure of several nodes is obtained with the help of this proposed algorithm. This algorithm increase the network lifetime as well as provides the stability to the wireless sensor network.

Yu Shaojun, et.al (2017) presented on the basis of the analysis of overall energy consumption rate in the wireless sensor networks, they compared and analyzed number of testing methods used in the power consumption of nodes. They analyzed, the end device process of the transmission data in which they do not specify the analysis on access node at which data is received, poor performance of this test in real time and more consumption of energy for the calculation and analysis of waveform data of the oscilloscope [11]. With the help of sampling of output, it improves the amplifiers with the help of using A/D, on a single-chip microcomputer calculated the power consumption of node at different intervals of time.

Tenager Mekonnen, et.al (2017) proposed a novel approach called Container-based virtualization. This approach is widely utilized to understand the use of Cloud of Things. The proposed approach also analyzed the incorporation of present intelligent objects in the cloud [12]. They also analyzed the running containerized software on the basis of battery-powered IoT devices which causes more overhead. They investigated the Docker based container virtualization and it's overhead on surveillance camera sensor nodes with the help of multi-tier WMSN prototype. More than 13% expenditure of power is measured as an overhead on the camera nodes in the process of boot-up and shutdown.

H.Oudani, et.al (2017) focused on a major factor called energy saving occurring in WSN. Saving of energy is very important in the networks so that rate of energy consumption is decreased [13]. The major challenges faced by this network are the enhancement in the network's lifespan and energy competence improvement. They also developed various hierarchical protocols so that present network traffic toward the sink is reduced to greater extent due to which lifetime of the network increases. They presented a new approach which is the advancement of clustering LEACH protocols. As per simulation results, it is demonstrated that the network lifetime of the network can be extended up to 45% as this proposed approach minimizes the rate of the energy consumption and improves the lifetime of the network. In future, this work can be improved so that increases all the aspects of the sensor networks.

M. Kabrane, et.al (2017) reviewed main challenge experienced by the wireless sensor network in the field of

urban traffic management is extension of the lifetime of the network. For the simulation of the traffic in more real times, they used SUMO and OpenStreetMap (OSM) techniques as instead of using proposed algorithm only as used in previous papers. The obtained outcomes confirmed that presented technique confirms the previous method for which they used GLD simulator [14]. Therefore, the presented techniques performed better than other existing techniques. The proposed techniques showed their effectiveness by solving the issue of power utilization by sensor nodes. Its main objective is the reduction of information sharing among the sensor and the traffic light controller by which sent numbers of packets is minimized. The received data from WSN is processed by this algorithm, it also driven the period of the green light at different channels on the basis of length of queue.

Research Methodology

WSNs are self-arranged type of network. These networks have extremely small size sensor nodes. The power consumption is the main concern in this network due to these small sixed sensor nodes. A routing protocol named LEACH is a power competent protocol. This protocol is utilized for the reduction of power expenditure. In the present scenario, a lot of modifications have been made in this protocol to achieve the aim of reduced power expenditure. There are three levels of design in the proposed approach. These levels are leader nodes, cluster heads and gateway nodes. These nodes are utilized for data transmission. The different phases of proposed approach are described below:

Phase 1: Cluster head selection: The cluster head is the first phase of the network. The fixed amounts of sensor nodes are deployed in this network. In the centre of the network, the sink is installed. The messages within the network are flooded by the base station. The power of the signal is computed by the sink or base station. The nodes having signal strength beyond threshold level are suitable to be chosen as the cluster head.

Phase 2: Leader node Selection: The leader nodes are selected within the network in the second phase of proposed approach. Apart from the cluster head, the leader node is selected among other nodes in this phase. The data from the sensor nodes is selected by the leader nodes. The leader nodes forward this data to the cluster head.

Phase 3: Gateway node selection

The gateway nodes are organized within the network in the final phase of algorithm. The gateway nodes depend on the total amount of nodes. Equation 5 represents gateway nodes.

$$Gateway_{nodes} = \text{total number of nodes } /4 \ldots. \quad (5)$$

The gateway nodes are represented as the one forth part of the overall nodes. The optimum node is chosen among all gateways nodes for transmitting data to the sink. The equation 6 computes the distance between the base station and gateway node.

$$\text{Distance} = \sqrt{(x(i)-x)^2+(y(i)-y)^2} \quad (6)$$

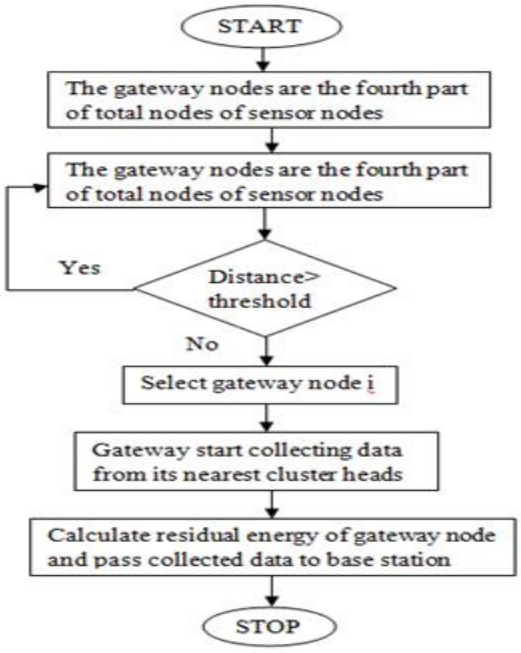

Figure 1: Proposed Flowchart

Experimental Results

MATLAB simulator is used to evaluate the proposed approach. Comparative analysis is performed against existing and proposed techniques to show the level of improvement achieved by this research.

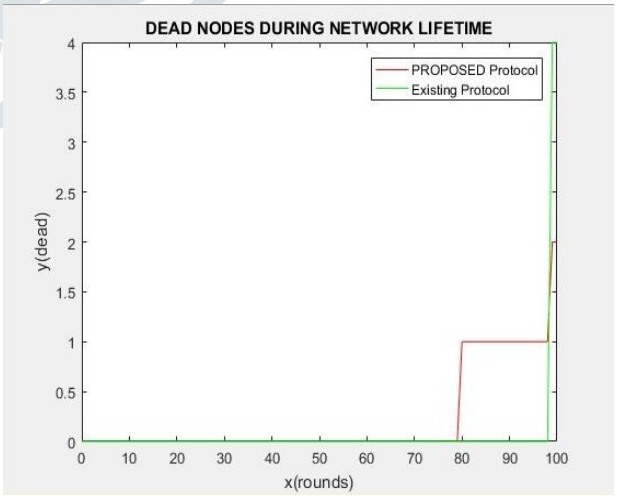

Fig. 2: Number of inactive nodes

Figure 2 shows the comparison of proposed and existing algorithm in terms of number of inactive nodes. The number of dead nodes in proposed work is four and in the existing algorithm it is two.

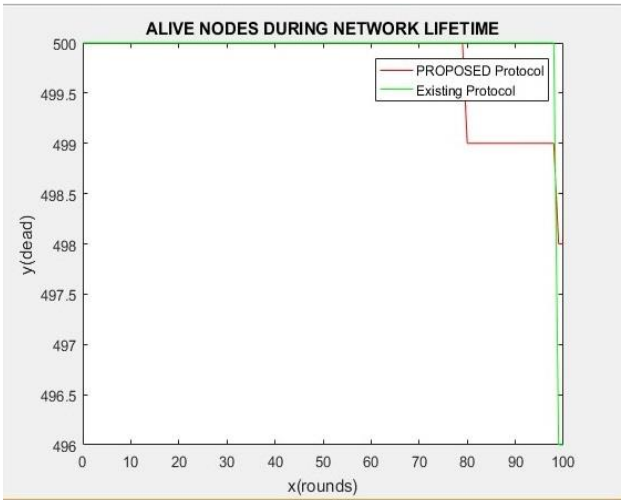

Fig 3: Number of active nodes

Figure 3 shows the comparison of proposed and existing algorithm in terms of number of active nodes. The proposed scheme has more number of active nodes than existing approach as per the analysis.

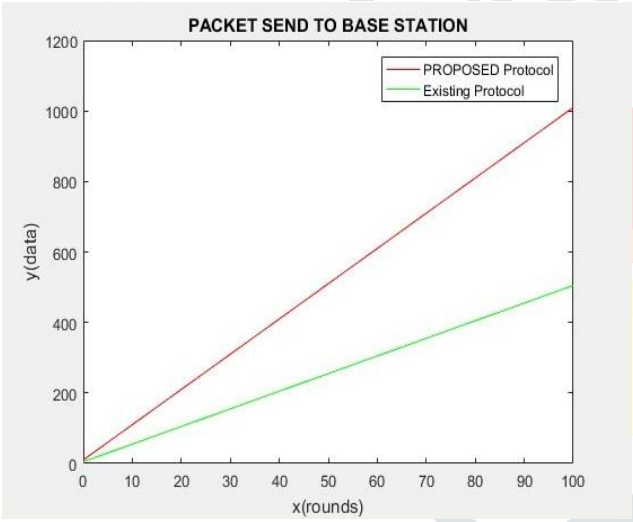

Fig 4: Number of packets transmitted

Figure 4 compares proposed and existing approach in terms of packet transmission. The proposed approach transmits more number of packets than the existing approach as per the analysis.

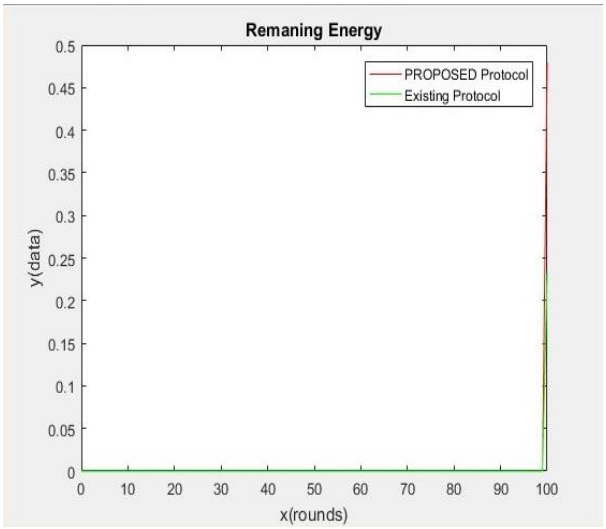

Fig 5: Residual Energy

Figure 5 compares proposed and existing approach in terms of residual energy. The proposed approach has more residual energy than the existing approach as per the analysis.

Conclusion

The wireless sensor network is a self configuring network. The deployment of this network is done at distant locations to sense environmental conditions. Deploying this network at distant locations causes a serious issue called energy consumption. The performance of the network reduces due to this issue. A protocol named WEMER forms cluster heads and leader nodes within the network. The information to the leader node is sent by the cluster head. The leader node further sends this information to the base station. In this research work, the WEMER protocol is enhanced using the gateway nodes. The cluster head send information to leader node which forward information to leader node. The leader node then forward information to gateway node. The proposed protocol is implemented in MATLAB and simulations shows upto 20 percent improvement in the results.

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