Novel Approach for Clock Synchronization in Wireless Sensor Networks

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Abstract- The wireless sensor network is the network which is used to sense the environmental conditions like temperature, pressure and so on. In this thesis work, further increment in RFID protocol will be proposed for the synchronization of the clock. In the proposed method the clocks of the nodes are correlated according to the time lay technique. If the time of the cluster head is not matched then the cluster head will automatically adjusts its clock in terms of the sink node timing and sensor nodes. The proposed technique has been applied in the simulations of the environmental conditions. The results from graphs show that the proposed algorithm performs better than previous protocols in terms of throughput, delay, overhead, energy consumption and so on.

Keywords- Clock Synchronization, WSN, Energy Efficiency

I. INTRODUCTION

A distributed type of network in which large numbers of sensor nodes are deployed such that the surrounding environment can be monitored is known as a wireless sensor network. A sensor node is small sized device that has limited battery power to perform its tasks. The data can be collected from surrounding regions and can be transmitted to the users after processing. There can be around hundreds to thousand numbers of sensor nodes deployed within a region of application [1]. There are however, less numbers of sensor nodes deployed within the ad hoc networks. Due to several improvements made in the processor and communication as well as involvement of less power embedded devices, wireless networks are being used very popularly within the industrial as well as commercial applications. The environmental conditions such as pressure, humidity, temperature, and so on can be monitored by deploying sensor nodes in the respective region. The tasks such as node localization, data aggregation, storage and retrieval processes, and data routing are performed by sensor nodes deployed within real time applications. Several low-powered sensor nodes are deployed within the region to be monitored by deploying WSNs [2]. The deployment done is self-configuring, self-optimized as well as self-protected. However, the major limitation of this network is the limited amount of energy provided by the nodes. The nodes perform tasks with the help of power provided through the battery present within them. The battery is thus the main source of power. The size of sensor nodes is however limited which also limits the size of battery present within them. The energy is consumed on the basis of operations performed by the sensor node [3]. After certain time duration, the nodes run out of energy and die. The dead nodes of the network affect the overall performance as well as lifetime of the network. Thus, it is important to provide new energy-optimized solutions within this network so that it can continue to perform tasks. The physical layer to application layer and the communication protocols are the various levels of the system hierarchy which all need to be considered individually for managing the energy consumption. Radio signals are used by sensor nodes for communication amongst each other. There is a sensing and computing device, radio transceiver as well as a power component which collectively generate a node [4]. Since there are many constraints found in these networks, new applications are provided by WSNs and to design the protocol, non-conventional paradigms are required. To determine the path through which the packets can be traversed from source to destination node, routing is performed. Since there is limited amongst of energy available within the sensor nodes, the lifetime of networks is also fixed. Thus, there is a need to design highly energy-efficient hardware and protocols for a sensor module keeping in mind the various aspects of the node. The lifetime of a system can be doubled when the energy usage factor is minimized. Thus, the overall usefulness of the system will increase here. Further, robustness of the node failures, fault-tolerance and scalability are certain factors using which the lifetime of system can be increased and energy dissipation can be minimized. Data centric protocol, Hierarchical protocol, Location Based protocol are the broader categorizations of various routing protocols of WSN. Efficient energy consumption, data aggregation as well as fusion are provided by applying hierarchical routing [5]. Designing an energy efficient system on the basis of energy levels of cluster head and cluster members is known as Low Energy Adaptive Clustering Hierarchical (LEACH) protocol. In comparison to direct communication LEACH provides various factors that help in minimizing energy dissipation. The lifetime of a network is increased by applying LEACH which was the first protocol introduced using hierarchical routing. Local clusters are generated by organizing all the nodes within the network. One node is chosen as cluster-head for each cluster. The data is transmitted to the cluster head by all the non cluster-head nodes present in the respective cluster. Various signal processing functions are applied on the gathered data by the cluster head and then the processed data is forwarded to a base station present in the network [6]. Thus, as compared to a non-cluster-head node, the energy intensity of the cluster head node is higher. Therefore, the communication ability of all the nodes present in the network is lost when the cluster-head of that cluster dies. The high-energy cluster-head position is rotated randomly through LEACH. Thus, the draining of battery of one particular node is avoided here. Also, there is an even distribution of the energy load of a cluster-head amongst all the nodes of the cluster. A TDMA schedule is created here to inform each node regarding the time in which the data is to be transmitted since the cluster-head node knows all the cluster members included [7]. Also, intra-cluster collisions are avoided for data transfer using a TDMA schedule. There are certain rounds in which the operation of LEACH is divided. When the clusters are organized, a set-up phase is executed to initiate each round. Further, the various data frames are transmitted from nodes to cluster head and then further to the base station within the steady-state phase.

II. LITERATURE REVIEW

Manju Gangwar, et.al (2017) proposed a novel approach using Bitmap along with the BEST-MAC protocol. An appropriate cluster head selection mechanism is also applied in this proposed work [8]. The energy efficiency of WSN is the major focus of the proposed work which includes six steps altogether. The existing technique is improved here using BEST-MAC protocol by focusing on several problems such as scalability, delay, overhead and energy efficiency. There are certain parameters that are mainly focused on by BEST-MAC. It is seen through the conducted experiments that as compared to the existing approach, the proposed work has provided enhancement in the process of cluster head selection.

Mohsin Raza, et.al (2017) proposed a MAC protocol that is based on time and provides emergency communications. This protocol is named as EE-MAC and for such data immediate channel access can be provided [9]. For the proposed protocol, a mathematical model is proposed in this paper. Comparisons are made here amongst the standard protocol and the proposed EE-MAC protocol which show that the channel access delay of emergency communication is minimized to 92%.

Konda. Hari Krishna, et.al (2017) presented the calculation of sensor systems with respect to the LEACH protocol. Within the remote sensor systems, LEACH is one of the prominent group based structures being used commonly [10]. By considering the major objective of adjusting the vitality usage, a TDMA based MAC convention is used by the filter. To investigate the execution of results of proposed approach, comparisons are made against the proposed and existing protocols in NS2. Energy consumption and network lifetime are two amongst the various parameters used to compare the performances of these protocols.

Weiqiang Xu, et.al (2016) presented a study related to TDMA based multi-hop wireless networks in which the optimization model is required for multi-hop information transmission as well as transmission of energy [11]. Further, for a unicast network environment, a nonlinear programming issue is proposed. For considering the energy consumption of compression, communication and wireless energy transfer, a highly realistic energy consumption model is proposed in this paper. For achieving the maximal source rate utility, a nonlinear programming issue is formulated. The network performance is enhanced by WET as per the results achieved here.

Jun Long, et.al (2015) proposed a novel approach for the general k-hop wireless sensor networks. The proposed approach is named as TDMA-based energy consumption balancing algorithm through which every cycle collects one data packet [12]. With the help of theoretical analysis, the longest network life is achieved when optimal k value is provided. This paper analyzed the highest energy consumption, the residual network energy and the timeslots (TSs) needed for the network. In terms of energy efficiency as well as TS scheduling, the proposed approach provides better results as per the simulations performed.

Marco Tiloca, et.al (2015) proposed a distributed and dynamic solution in order to resolve selective jamming within the TDMA-based networks which is known as JAMMY [13]. At each superframe, the slot utilization pattern is changed by JAMMY due to which the adversary cannot predict it easily. Since the next slot usage pattern is determined in a distributed and autonomous manner by the sensor nodes, the JAMMY is known to be decentralized in nature. Negligible overhead is introduced along with joining of multiple nodes in the network when limited number of superframes are present, by JAMMY as per the results achieved through the evaluation of proposed approach.

III. RESEARCH METHODOLOGY

Initially, the sensor network is deployed with infinite number of sensor nodes. The sensor nodes are grouped together to form clusters depending upon the similarity amongst these nodes. Each cluster chooses a cluster head with the help of an election algorithm. A cluster head is chosen on the basis of the node that has higher number of resources and residual energy. The data that is collected by various nodes is forwarded to the cluster head which is then forwarded to the destination end. The route that is to be followed for transmission is discovered by the AODV routing protocol. Further, the path from source to destination is generated using this discovered route. The AODV routing protocol discovers dynamic paths that are known as virtual paths.

To ensure least packet collision within the network, it is important for the sensor nodes to be synchronized with cluster head. Every network contains a sink within it. A cluster head node is available within the clusters. From one cluster head, the message is initially transmitted to the sink. The transmission delay of message will be reduced once the message is received by the sink and the current time is computed. The sink sends the message to the similar cluster head at the end. Once again, the transmission delay will be eliminated from the message and time will be calculated by the cluster head. Thus, the final delay which is the transmission delay of sink – the transmission delay of cluster head is achieved here.

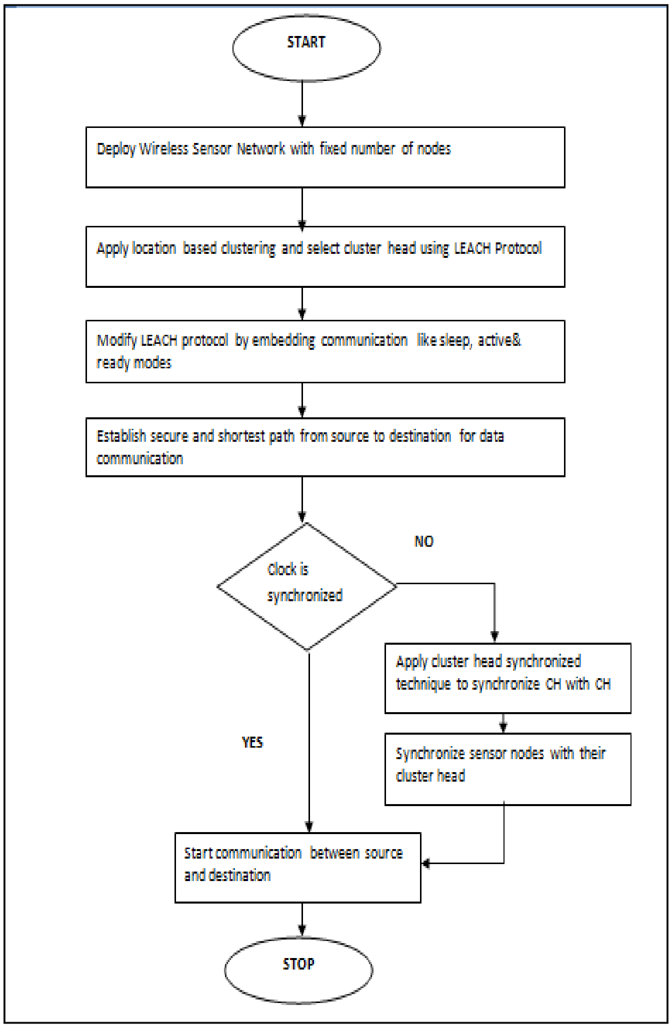

Fig.1: Proposed Flowchart

IV. EXPERIMENTAL RESULTS

The proposed algorithm is applied on the NS2 and used to evaluate its performance; the technique is compared with already existing techniques based on several parameters.

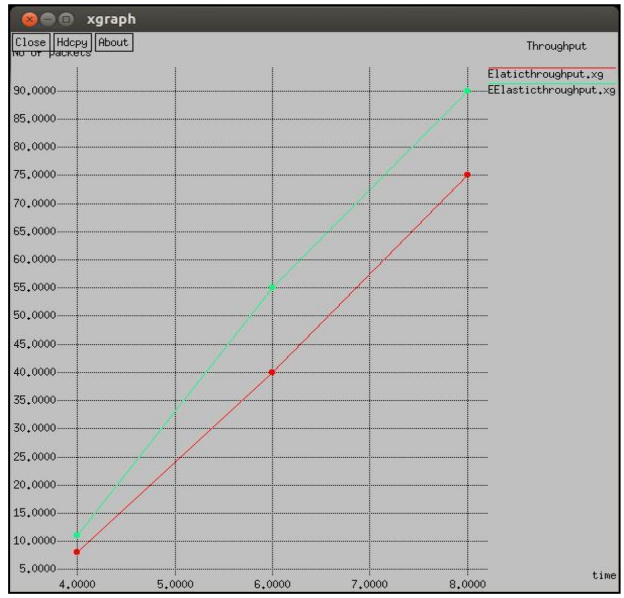

Fig.2: Comparison based on throughput

Figure 2 illustrates the throughput graph and the comparison between the new and already existed technique. The red line represents the throughput value and green line represents the previous work. Throughput value is more in the modified work as there is co-ordination between nodes and no packet loss. It is measured in terms of packet sent per second.

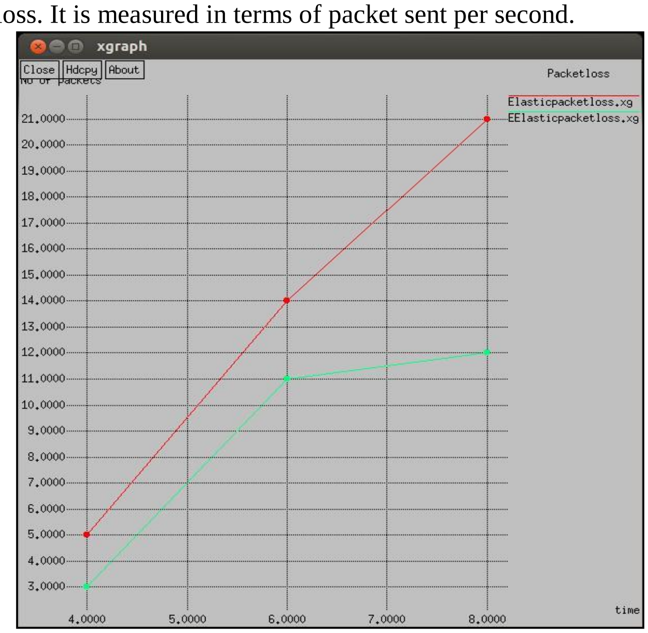

Fig.3: Comparison based on packet loss

Figure 3 demonstrates packet loss in the system. Green lie indicates the packet loss in the proposed work whereas red line indicates the packet loss in the existing techniques. Packet loss is decreased because there is synchronization in the clock technique which reduces the collision and packet loss.

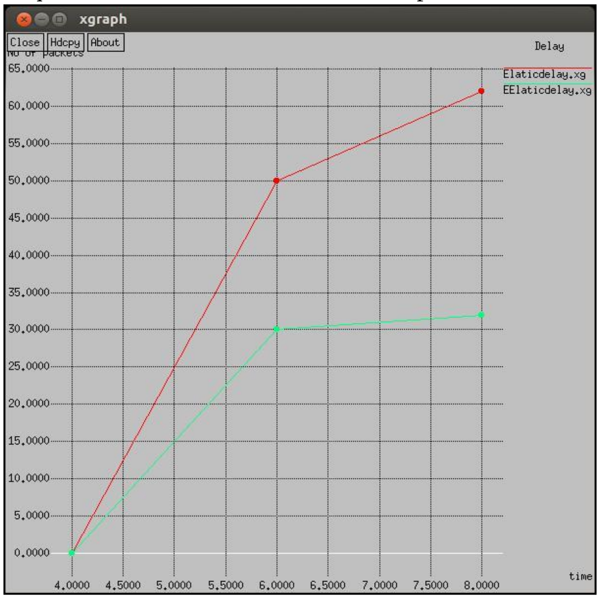

Fig.4: Delay Graph

Figure 4 displays the result in the delay. Here, green line indicates the delay in proposed work and red line indicates the delay on existing method. delay is decreased in the proposed work due to its synchronization.

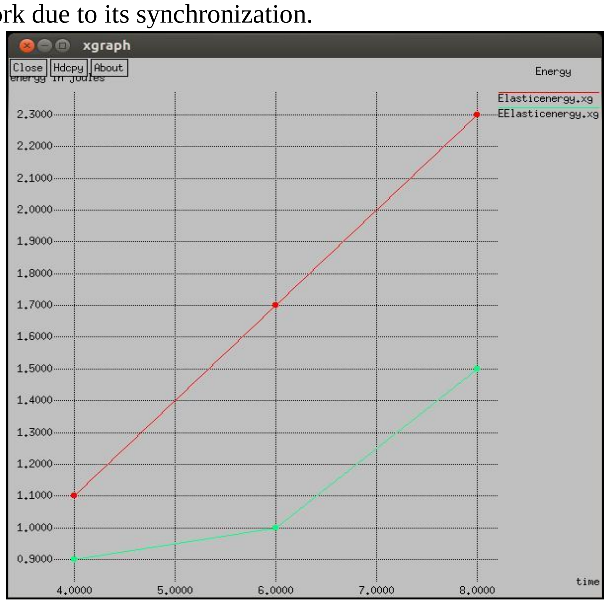

Fig.5: Energy Consumption Graph

Figure 5 illustrates the energy consumption in the system. The red line represents the existing work's energy consumption whereas the green line represents the energy consumption of the modified or the proposed work. The energy consumption value is decreased in modified technique because synchronization is performed with time lay method.

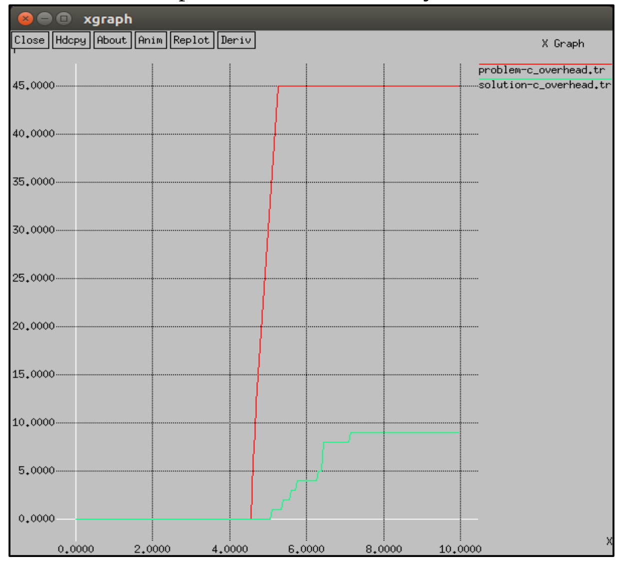

Fig.6: Overhead Graph

Figure 6 displays the overhead results .green lines shows the overhead in the proposed work which s quite less as compared to the existing method which is because of the correlation between the nodes. Packet loss is reduced and hence message overhead.

V. CONCLUSION

In this work, a clock synchronization technique is implemented which match the timing of each node with one another. Cluster head matches its timing with one another and with the base station. So, according to this synchronization is achieved. Hence, the process is applied on NS2 and results are compared which are based on certain factors like throughput, energy consumption, packet loss, and so on. Therefore, the results show that the proposed technique is better in terms of above listed factors. Hence, it is conclude that upto 15% of energy gets saved after improving the synchronization technique which leads to increase the network lifetime.

VI. REFRENCES

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