OPTIMAL DUTY CYCLING USING COMPATIBILTIY AND ROLE CHANGE TIMER FOR WSNs

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Abstract: **The wireless sensor networks (WSN) are widely used in the variety of data collection applications around the globe. The popular uses of WSN include the military, weather, agriculture, healthcare and many other sectors. The WSN suffers from the intense problem of throughput, which primarily occurs due to the network overhead occurred due to the various reasons. There are multiple ways, which can be used to increase the throughput of the network, but none of them is capable of increasing the efficiency more than 10%. In this paper, the work has been carried upon the duty cycling, which is associated with the sleep-awake scheduling for the purpose of throughput maximization. The proposed model utilizes the robust pairing mechanism for the sensor nodes, which has been designed on the basis of compatibility factor. The compatibility factor acts as the trust factor to create the node pairs between the most compatible nodes. The performance of this model is optimized by combining the role switch timer and compatibility factor. The proposed model has been observed with the improvement throughput, which is observable from the obtained results. The best combination out of all is fourth combination (beta=0.5, alpha=0.5), which is observed with approximately 0.51 throughput against the 0.450, 0.458 and 0.487 values for the other three combinations. Also, the variation of the throughput on all of the events is not found similar on any of the two events.**

Keywords: **duty cycling, WSN, throughput maximization, time optimization.**

INTRODUCTION

With new inventions in technology that allowed a wireless node device to have higher cost performance and better as high-resolution detection capabilities, observations over large areas for a number of detection devices became possible. Networking of these smart devices yet low-cost wireless nodes to revolutionize the collection and processing of information in many situations.

- **Agriculture**: In agriculture, WSN is used to detect and monitor the condition of crops that promotes culture harvest lot by reducing their cost value cultivated crops also helps to improve the quality of crops.
- **Monitoring Weather**: In the forest, WSN is used to detect rain and bad weather.
- **Monitoring and controlling traffic**: measure the percentage of traffic on a road.
- **Solar energy**: wireless nodes contribute to the production of electricity, and also used in the collection of solar energy WSN which follows the sun's rays to detect power.
- **Health care and medical research**.
- **Homeland Security**: WSN are used in monitoring staff in a building.
- **Military applications**: In military WSN is used to detect and monitor the surrounding areas for any type of event. WSNs are there to detect and track tanks on a battlefield.
- **Monitor environmental pollutants**.
- **Detection of chemical and biological agents**.
- **Forest fire detection**: Using WSN detects fires in a forest is another example where wireless nodes are used to detect such fire events occur. After detection wireless node nodes, the BS reports to the location where the fire event occurred and then BS in response are some physical action such as sending the fire trucks are here immediately.
- **New areas continue to emerge**.
- **Detecting intruders**.
- **Natural disaster monitoring**.

- **Agriculture Monitoring:** It can use in crop and livestock management and precision control with nodes placed on animals tracking their movement or temperature, managing the feeding of individual animals, automating the distribution of medicine for individual animals, etc.

- **Health Care:** Small sensor nodes could be used for medical applications like surveillance of elderly people. Devices that are carried around or which are worn with the clothes like it is proposed in the field of Wearable Computing could monitor vital function and report them to the family doctor or directly to the ambulance in case of an emergency like a heart attack. In the future small sensor nodes could be implanted into the body in order to detect internal diseases like cancer at an early stage. This way it can be treated earlier, when the recovery probabilities are much higher.

All these wireless networks characteristics are completely opposite to wired networks because in the cords of the energy consumption networks are not a problem. Unlike the applicability of various wireless networks, the battery capacity in their nodes is very limited, and it is unrealistic to replenish the battery nodes in many cases. Therefore, the preservation of this vital energy to each wireless node is significantly important in wireless networks.

LITERATURE REVIEW

Ji et. al. has worked on the throughput-outage trade-off mechanism for the wireless networks connected with the one-hop distance based mostly limitation. The authors have characterised the optimum throughput-outage trade-off in terms of tight scaling laws for numerous regimes of the system parameters, once each quantity of nodes and therefore the number of files within the library grow to time. **Zeinali et. al.** has worked on the study of impact of the compression and aggregation techniques over the wireless networks by mistreatment the good meter information. The aim of this work is to analyze completely different compression techniques within the context of the good grid communication infrastructure. The authors have studied the performance of standard information compression algorithms applied to daily load profiles of a typical client residence. **Lv et. al.** has worked on the energy-balanced model for the information compression mechanism for WSNs. so as to adapt to the dynamic modification of constellation, the author have designed the mobile agent based mostly compressive information gathering algorithmic rule (MA-Greedy), wherever every device node is uniformly visited in M measurements. constant of Variation (CV) is projected to judge the balance of energy consumption. **Rambabu A. Vatti** has worked on the wireless networks to analyze their overall throughput under the various circumstances. In this paper, the authors have projected an answer to resolve the matter of packet loss because of over usage of the intermediate nodes. The authors have projected a routing rule supported the remaining energy at the intermediate nodes. **Krishnan S. S. et. al.** has worked on the Energy consumption and CO two emissions by the Indian mobile medium business. The Indian mobile medium business, one in every of the quickest growing sectors in India, had 584.3 million subscribers in 2010–2011 registering associate degree annual rate of forty nine.15%. The energy consumed by the arena was 163 PJ and also the corresponding CO_2 emission was calculable at thirty two.9 million tons. **Amanna et. al.** has worked on the study of inexperienced communications. The developing world has turned to wireless communications as a leap frog technology past wired communications that spurs its growth even plenty of. at an equivalent time, the commercial world has developed associate unsatiable demand for broadband info delivered through their radiotelephone set. **Charan R. et. al.** has worked on the economical analysis of the Leach protocol for energy potency within the wireless networks. to increase the period of WSN the LEACH protocol is enforced by forming clusters for routing during a massive scale network. **Scott Briles et al.** (2005) describes the graphical programming tools used to implement a new geolocation algorithm composed of Windowing, FFTs, complex multiplies, spectral averaging, and the arctan function. The presentation may be of interest to our GUI efforts. **Raymond Wagner et al. (2005)** has proposed the multiresolution data analysis, processing, and compression. There are two factors: First, typically sensor data are spaced. Secondly, the overhead involves in communication among sensor nodes in some multi-scale algorithms can become prohibitive.

EXPERIMENTAL DESIGN

The pairing of the nodes has been proposed in the active model under the proposed model in this thesis. The proposed model is designed to actively track the energy levels of all the nodes in the given cluster, which are further taken into account to compute the vertical alignment of the nodes in relationship with base station. The node relationship representation based on horizontal alignment is not considered to be much effective, as many of the paths can remain incomplete due to the improper active node cluster. Such conditions are considered hazardous in the case of wireless sensor networks. The lack of information is intended to provide the unreliable results, and also these can alleviate the wrong decision. In order to prevent the improper network situation, the vertical alignment based node pairing is considered to be effective, where the higher probability of the path formations is taken into account. Under the sleep scheduling models, the network is divided into multiple sequential clusters programmed to work on different events divided on time scale. The pairing of the nodes must be efficient and must take maximum paths into account, which prevents the data loss from the given cluster. Also, the overall lifetime of the cluster is maximized using the sleep scheduling models. The proposed model based upon the vertical alignment based pairs is supposed to resolve the various problems associated with network lifetime and path failures. The algorithm is described in the following section:

Algorithm 1: Vertical Alignment based Pairing of Nodes for the Lifetime Maximization

1. Start the WSN nodes in the given cluster
2. Base station is powered up and put to the active status

3. All of the sensor nodes are requested to provide their information to all other nodes using the information request broadcast
4. All nodes replied with their coordinates (generally X and Y) to all of the nodes in the neighborhood
5. Several kinds of parameters are computed for each of the neighboring nodes
    a. Firstly, the distance between the nodes is evaluated using the squared distance equation
    b. Then, the angle and skewness is measured using the trigonometric functions to evaluate the intensity of vertical alignment to the base station
    c. Also compute the vertical elevation of the nodes in order to evaluate the compatibility between two neighbors
    d. Discover the neighbor, that best fits the evaluating node
    e. Assign the best fit neighbor and the evaluating node in the active pair
6. The network clusters are prepared using pair information
    a. All of the nodes in first column becomes the member of first cluster
    b. All of the nodes in second column becomes the member of second cluster
7. Firstly, the nodes of first cluster are turned on, and nodes of second cluster are put to sleep
    a. Note: This rotation is time-based event, and runs according to the time slots.
    b. The clusters will switch their roles, as active becomes sleeping and sleeping becomes active
8. The network paths are computed for each of the cluster towards the base station nodes
9. All nodes then forwards the data towards the base station
10. Once the simulation time is over, the network parameters are computed and returned as the final result

RESULT ANALYSIS

In this paper, the results of two experiments have been evaluated, which are distinguished on the basis of role switch time (denoted by alpha) and trust factor between two nodes for pairing (denoted by beta). In the first experiment, the value of the alpha parameter is used to control the timer for the eventful sleep scheduling, whereas the beta parameter gives the trust factor or compatibility between the paired nodes. The trust or compatibility factor controls the robustness of the node pairing for the establishment of the given network segment. This table shows the results of the proposed model collected in the form of throughput parameter, which indicates the overall capability of the network to process the particular volume of data per unit time (where the per second is generally considered as per unit time).

Table 1: Descriptive analysis of throughput parameter based analysis of the simulation with the varying value of alpha

	alpha=0.2, beta=0.8	alpha=0.3, beta=0.8	alpha=0.4, beta=0.8	alpha=0.5, beta=0.8
Min	0.39	0.41	0.46	0.49
Max	0.455	0.463	0.49	0.52
Mean	0.4475	0.457766667	0.480966667	0.497666667
Median	0.453	0.46	0.48	0.5
Range	0.065	0.053	0.03	0.03

In the table 1, the descriptive analysis of the throughput based upon the variable alpha value, i.e. sleeping and awakening mode switch timer, in the simulation of 30 seconds of length. The variable alpha values are used to determine the best combination of the variable alpha and constant beta value, which is determinable by the highest value of throughput throughout the simulation period. While evaluating the performance of the proposed model, all of the four combinations show the different values of the throughput.

In second experiment, the value of the beta parameter is used to control the trust or compatibility between the two nodes for pairing, whereas the alpha parameter denotes the timer to switch the roles between the paired nodes. The beta (i.e. trust or compatibility) factor controls the robustness of the node pairing for the establishment of the given network segment. This table shows the results of the proposed model collected in the form of throughput parameter, which indicates the overall capability of the network to process the particular volume of data per unit time (where the per second is generally considered as per unit time). The total 30 observation are observed from the simulation, which is given by the Index (or seconds). This means the total simulation account for the 30 seconds, before producing the final statistical results. The different trust or compatibility options involve time between 0.2 and 0.5 seconds, whereas the timer has been kept constant on the value of 0.5. The time factor has been kept at 0.5, because it's the best value observed from the second experiment.

Table 2: Descriptive analysis on throughput parameter based analysis of the simulation with the varying value of beta (trust factor or compatibility)

	alpha=0.5, beta=0.2	alpha=0.5, beta=0.3	alpha=0.5, beta=0.4	alpha=0.5, beta=0.5
Min	0.39	0.414	0.454	0.5
Max	0.46	0.464	0.484	0.517
Mean	0.448	0.4579	0.477033333	0.507266667
Median	0.453	0.4615	0.478	0.507
Range	0.07	0.05	0.03	0.017

In the table 2, the descriptive analysis of the throughput based upon the variable beta value, i.e. trust factor between the paired nodes, in the simulation of 30 seconds of length. The variable beta values are used to determine the best combination of the variable beta and constant alpha value, which is determinable by the highest value of throughput throughout the simulation period. While evaluating the performance of the proposed model, all of the four combinations show the different values of the throughput.

CONCLUSION

The proposed model is based upon the duty cycling. The proposed model has been designed by combining two main factors, where one is designed to switch the node roles, and another to control the pairing by using the compatibility based factor known as trust factor. The major aim of the proposed model is to establish the optimal configuration by optimizing the trust factor and role timers to obtain the best network performance. The total 30 observation are observed from the simulation, which is given by the Index (or seconds). This means the total simulation account for the 30 seconds, before producing the final statistical results. The different timer options involve time between 0.2 and 0.5 seconds, whereas the trust factor (compatibility) has been kept constant on the value of 0.8. The trust factor of 0.8 is considered sufficiently higher to create the robust pairs of then nodes. Observed from the first simulation experiment, the best combination out of all is fourth combination (alpha=0.5, beta=0.8), which is observed with approximately 0.50 throughput against the 0.45, 0.46 and 0.481 values for the other three combinations. However, the variation of the throughput on all of the events is similar for alpha values of 0.4 and 0.5, which is given by the range parameter. According to the second experiment, the best combination out of all is fourth combination (beta=0.5, alpha=0.5), which is observed with approximately 0.51 throughput against the 0.450, 0.458 and 0.487 values for the other three combinations. Also, the variation of the throughput on all of the events is not found similar on any of the two events.

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