ISSN 2395-1621

Data Reduction For Energy Minimization In Wireless Sensor Networks

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ABSTRACT

Wireless sensor network (WSN), as the name depicts itself includes sensing and routing with the help of nodes. A sensor along with its hardware apparatus and external environment, collectively called as a node. Each node needs to sense environment and transmit data to the sink. Each node is equipped by a battery, but it is very difficult to recharge or replace the battery, therefore the query of network lifetime came into the existence. Hence to maximize the life of network the energy minimization came into the spotlight. Energy minimization is one of the top grossing topic in WSN nowadays. One of the method for attaining it is by data reduction i.e. by omitting transmission. There are several techniques present in this field , but we will mainly deal with two main techniques such as Threshold Level Sampling and Adaptive Threshold level sampling respectively. In this project we will be taking environment monitoring system as a case study for attaining the aim. The further software study and analysis of techniques will be done by using open source software. By this extensive study, we are duly going to study about some energy minimization techniques by algorithm in the favor of energy minimization. Thus by saving energy consumption, lifetime of whole network is prolonged.

Index Terms— Data Reduction, Energy Minimization, Threshold Level Sampling , Adaptive Threshold Level Sampling, Environment Monitoring.

ARTICLE INFO

Article History

Received :5th April 2016

Received in revised form : 7th April 2016

Accepted : 9th April 2016

Published online : 11th April 2016

I. INTRODUCTION

Wireless sensor network basically works on the duly famous principle of many-tiny, which states that wireless network consist of thousands of inexpensive miniature devices capable of computation, communication and sensing. The principle states that many sensor nodes are connected together without any wires, i.e. no physical contact between the nodes is established. It has a wide range of applications in environment monitoring, surveillance, medical systems, robotic exploration, military, weather monitoring etc. These nodes are designed to perform various sensing tasks and the output data of the operations is further used for monitoring according to several human interests. Each node consists of several sensors, hardware apparatus and environment. These nodes can be heterogeneous and can also be homogeneous in nature based upon the operation to be performed.As we know, entire globe faces a huge economic loss due to forest res or wildres every year. These res basically are Result of human negligence and unnatural environmental conditions and atmospheric imbalance. The loss caused by these forest re counts in billions of U.S. dollars sometimes.Though wildfires or forest fires are the short lived and sudden disasters but causes huge forest destruction and loss of wildlife. Our studies will basically use smart forest re management as primitive case study and sensor networks consisting of nodes designed to sense certain parameters such as temperature, humidity and atmospheric pressure required for re detection and will achieve energy minimization goal through it. As we have discussed, each node is embedded with the some external power resource. This power resource can be batteries, direct electric supplies or natural resources. These external power houses are connected to nodes in ad-hoc manner, thus it is very difficult to change, recharge or manipulate them, which results in limited life of nodes or WSN environments. Hence to increase the life of the WSN environment and minimizing the energy usage, various techniques are proposed Though there exist various techniques which deals with energy minimization, but here we are going to study about energy sustenance with the help of data reduction. The two famous approaches included in data reduction techniques are Threshold level Sampling and Adaptive Threshold level Sampling. Using these algorithms the data transmission to the sink node is decreased without affecting the efficiency of the application, which further leads to decrease in energy consumption of sensor nodes.

A. Objective

- To Remove Data Redundancy.
- To Increase the life of Network by minimizing the energy utilization of sensor nodes.

II. RELATED WORKS

Wireless sensor network has shown rapid development in recent years. Energy conservation have been significant prior- ities in many research studies. In relation to previous work, various problems occurred regarding energy minimization. Some of the research work proposes the various solution to the aroused problem. Work proposed for landslide monitoring has proved to be very useful for holding energy minimization techniques. The study of radio components which are the main causes of energy consumption is attempted to conclude energy minimization. The basic strategies given are TLS and ATLS. Other strategies can be referred as data compression and aggregation, predictive monitoring, topology management, adaptive duty cycle respectively.M Vinodini, Ramesh, VP Rangan in [1] states Data reduction techniques are followed up with help of one,dual,tri,quad sensors and it then proposes energy minimization mechanisms and their implementation via co- operative and co-ordinated action by each of the sensor. Sensors are deployed in landslide prone areas for landslide moitoring.

Ramchandran, Chandrasekar, Sudip Misra, and Mohammad S. Obaidat. in [11] A probabilistic zonal approach for swarm inspired wildre detection using sensor networks. International Journal of Communication Systems 21.10 (2008):1047-1073 has respectfully shown the working of sensor network for re detection with utter accuracy and optimality.

C Alippi, MD Francesco, M.Roveri in [2] Proposes Adaptive Sampling Algorithm Which when used in combination with a duty cycle technique then ASA algorithm can save up to 97 Percent of energy consumed by the snow sensor when it is always on.

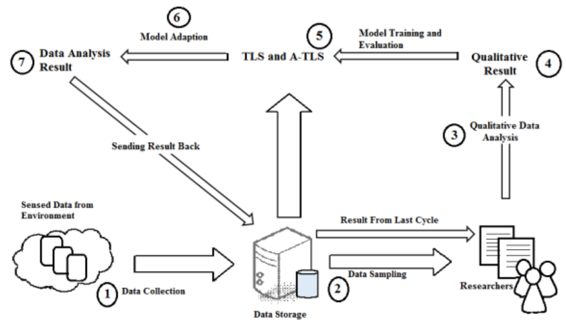
C Alippi, MD Francesco, M.Roveri [3] proposes ASA Algo- rithm for WSN capable of dynamically estimating the optimal sampling frequency of the acquired signals and We found that ASA is able to reduce the number of acquired samples up to 79 percent w.r.t. the fixed sampling frequency for corresponding energy saving of both.

ZHANG Meiyan,Zheng Xiaodan in [4] proposes an energy efficient ASA which schedules sensor nodes in spatial region so as to reduce energy consumption. By adaptively sampling ROI, fewer sensors are activated at the same time and required communications are reduced, in order to achieve significant energy conservation.

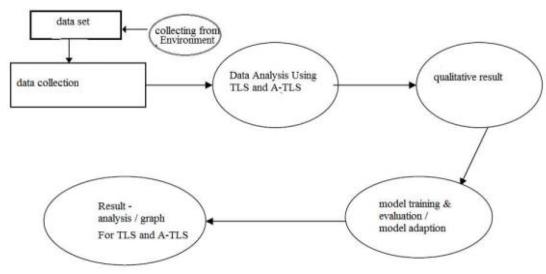
M. Lourthu Hepziba Mercy, K. Balamurugan in [5] states in his paper major decrease in energy consumption and overcome of latency problem and results demonstrate the trade-off between latency and energy consumption under varying duty cycles and for different packet arrival rates.

Soua, Ridha and Pascale Minet [6] surveyed numerous tech- niques for handling the issue of energy conservation in WSN. Techniques are presented for effective utilization by a system- based approach and network-based approach. Hybridization of the techniques proves to be more efficient than traditional techniques.

III.SYSTEM ARCHITECTURE



Data Flow Diagram



ALGORITHMS

A. Threshold Level Sampling

In TLS technique , the sensor transmits the data to sink only when certain declared threshold level is crossed, and total energy consumed by each sensor can be obtained by taking Equation:-

- Eday = Sday(Esmp + BsmpExmt)

and substituting Sday = Number of times the threshold value is exceeded in a day. The TLS technique improves the battery by considerable large margin. As in the study of rainfall detection the data transmission policy ranges from 500 bytes/day to 350 bytes/day and total energy consumed by each sensor could be calculated from the equation given above. As a result battery life got increased by 43 days and 63 days at lowest and highest threshold level.

Pseudo Code of TLS Algorithm.

- Input:
- Sensed data = S,

- Threshold Value = T
- Algorithm:
- Repeat following steps for predefined time slot.
- 1) Accept S
- 2) If [S ¿ T]
- 3) Send Data to Sink
- 4) Calculate energy consumed
- 5) Repeat Step 2
- 6) End process

When the sensor node senses a new data S, it checks, if the sensed data is greater than predefined threshold value or not. If it is greater than threshold value, the data is transmitted to the sink else the mentioned steps are repeated, finally checks for the Total energy consumed during the process. Mathematical Modelling: The energy utilized by sensor node can be calculated as follows:

ETotal = S ES + t ET + P EP

Where,

- ETotal = Total Energy consumed by Sensor S = No. of Sensed Values
- ES = Energy required for sensing one value
- t = No. of Values Transmitted to other Sensor Node
- ET = Energy required for transmission from sensor to sink. P = No. of values processed
- EP = Energy required for processing one value.

B. Adaptive Threshold Sampling

In this technique only one among the various sensors is subjected to predefined threshold value while other sensors are kept in dead state. These dead sensors gets activated only if the predefined favourable sensor crosses the threshold value. In simple words the sensors other than the favourable sensor gets activated one by one according to their interdependency or pre-declaration between respective threshold values. Similarly, The ATLS technique has proven to be more reliable than TLS and it improves the battery by quite large margin as compared to TLS. As in the study of rainfall detection the data transmission policy ranges from 150 bytes/day to 50 bytes/day and total energy consumed by each sensor could be calculated from the equation given above. As a result battery life got increased by 150 days and 400 days at lowest and highest threshold level.

IV. MATHEMATICAL MODELLING

The energy utilized by sensor node can be calculated as follows:ETotal = S ES + t ET + P EP

Where, ETotal = Total Energy consumed by Sensor S = No. of Sensed Values ES = Energy required for sensing one value t = No. of Values Transmitted to other Sensor Node ET = Energy required for transmission from sensor to sink. P = No. of values processed EP = Energy required for processing one value. Success Conditions: Increased Lifetime of Sensor Network. Failure Condi- tions: Energy Loss and Data Duplication.

V. ASSUMPTIONS

- The designed system will be a event based system.
- Intial energy source attached to each node will be 10000j.
- Energy required for sensing one value will be 50j.
- Energy required for transmission of single value from source to sink will be 100j.

VI. CONCLUSION

The techniques of TLS and ATLS are effectively utilized for the purpose of Data Reduction. Data Reduction ensures lower amount of data to be transmitted over the network which will subsequently lower the energy consumption considerably.

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