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Simulation of Energy-Efficient Transmission Scheme in WSNs by using CNS

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Abstract:
Wireless Sensor Networks (WSNs) are resource constrained in terms of limited battery energy, bandwidth, memory, and processing performance. The energy consumption is the major research issues due to limited battery power while designing the algorithms and routing protocols for WSNs. At every level of WSN operations such as computing, routing, sensing etc. efficiency in energy is required. The consumption of energy in radio communication is majorly depends on number of bits of data which is to be transmitted between sensor nodes. The bits are then encoded into the packets during the transmission process through the routing protocol. The consumption of energy can be reduced by compressing the bits before transmitting at transmitter. Compression helps to reduce the total number of bits to be transmitted and hence resulted into energy consumption reduction and improves the network lifetime. In this paper, we are presenting the Compression with Null Symbol (CNS) method and the modified CNS (MCNS) compression methods while transmitting data from transceiver to receiver in WSNs. MCNS is based on existing CNS technique by using the adaptive fuzzy based encoding algorithm with CNS technique. The CNS and MCNS are designed as WSNs routing protocols and compare their performance in terms of energy efficiency, network lifetime and data rate performance using NS2.

Keywords: Encoding, Data Compression, Sensor Networks, WSN, CNS, Energy Efficiency

I. INTRODUCTION

In general, Wireless Sensor Networks (WSNs) is nothing but collection of small and tiny sensor nodes without any physical infrastructure. The WSNs is described by the implementation of a big range of low cost, battery high-powered devices that is expected to control over long periods of span. Typically, WSNs face the hurdle of standard replacement or recharging of the batteries of the sensing element devices like the networks usually tend to be deployed for observation or or CCTV functions in critical to access or unfriendly terrains. With communication being crucial to the operations of such networks and communication being the essential client of energy, architecture of energy efficiency communication schemes for WSNs is of predominant importance [1] [2]. The many recent researchers has been targeted on reduction of energy consumption basis on mack layer plan, optimizing data transmissions by reducing collisions and retransmissions & via intelligent choice of ways or special architectures for digital communication. Zhu et al. presents numerous models of energy consumption in wireless ad hoc networks that take under consideration energy consumption because of data packets, management packets and retransmissions. Wang and Manner investigates the utilization of information compression techniques to decrease the consumption of energy in mobile networks. Their investigation reveals that content-aware compression will considerably decrease the energy needed for wireless digital communication [3]. In 2005, Zhu and Sivakumar recommended the recent communication strategy known as Communication through Silence (CtS) that involves the utilization of silent time periods. CtS, however, suffers from the disadvantage of being exponential in communication time. Another strategy, known as Variable-Base implied Communication (VarBa- TaC) was projected in this uses a variable radix-based data cryptography as well as CtS for communication [4]. However, for the n-bit binary string the period of transmission is, in general, considerably longer than n. Neither CtS nor VarBaTaC addresses the problem of crucial the quantity of energy saved for clattering channels [5]. In order to understand energy-efficient communication in WSNs, one wants to address the energy-saving measures on all potential fronts like, applicable Macintosh protocols, source coding techniques to boost the prevalence of silent intervals throughout radio transmission, energy-efficient digital modulation techniques and their acceptable mixtures. Whereas numerous investigations are administered during this direction, the mutuality between of the source code and modulation techniques remains to be explored [6]. Specifically, with acceptable for the source code of a binary information stream, it should be attainable to convert a given binary bit stream into a stream of m attainable symbols (m>2), with one amongst the symbols occurring with higher possibility than the remaining m - 1 symbols. As the example, we tend to demonstrate such a code during this paper with m = 4. One may then select to transmit the stream of m equations through an acceptable digital modulation theme during which the transmitter is unbroken silent throughout the prevalence of the dominant symbol. By this system, throughout the silence intervals, the transmitter will save important quantity of energy. The approaches rearrange binary information to the redundant binary numeration system. Our projected CNS theme is predicated on coding binary data to number 4 [7]. To transmit a stream of m possible symbols (m>2), one may then choose to employ m-ary PSK/FSK modulation scheme. However, when the occurrence of a silent symbol comes into play, the receiver gets into the extra drawback of raise demodulation together with the PSK/FSK demodulation for the remaining m - 1 equation. As a result, for the detection of the silence of any carrier wave shape in presence of band pass noise waveforms, the fast power levels of the m - 1 non-silent symbols might need to be enhanced suitably, because of the comparatively inferior (higher) signal to noise ratio (SNR) necessities of provoke an equivalent BER cost (as compared to the fast power level that might are needed if all m PSK/FSK waveforms were transmitted). Thus, though apparently some energy is saved throughout silent symbols, the detection of symbols in each non-silent and silent intervals with acceptable BER performance would possibly increase the transmit power for the nonviolent symbols using m-ary PSK/FSK modulation theme. Most of existing data-driven energy management and conservation approaches for WSNs target reduction in communications energy at the value of enhanced computational energy. in theory, most compression techniques work on reducing the quantity of bits required to represent the perceived information, not on the reducing the quantity of perceived data; therefore, they're unable to utilize sensing energy prices expeditiously in WSNs. significantly, in most cases, these approaches assume that sensing operations consume considerably less energy than radio transmission and reception. In fact, the energy cost of sensing is not always insignificant, especially when using power hungry sensors, for example, gas sensors. Hence designing the efficient compression method for WSNs is still research problem. In this paper, we are presenting two compression algorithms CNS as existing and MCNS as proposed. In section II, related works are described. In section III, proposed methodology and algorithms presented. In section IV, simulation results discussed, finally in section V conclusion and future work.

II. RELATED WORKS

The study of the various energy efficiency technique developed by the many researchers for WSN has been shown in this section.

In [1], author have developed Energy-efficient broadcasting in all-wireless networks, In this system the main focus on the problem of optimal broadcast, for which broadcast nature of radio transmission can be exploited to optimize energy consumption.

In [2], author proposed Telos: enabling ultralow power wireless research. In this system Telos is new mote design built from scratch based on experiences with previous mote generation. Minimal power consumption, easy to use and increase the software and hardware robustness are major goals of system.

In [3], author proposed another approach of energy-efficient data aggregation hierarchy for wireless sensor networks, In this system single level aggregation and proposed an energy efficient protocol for aggregation (EPAS). Along with the power consumption model & generalized compression the optimal number aggregators has been described by these system.

In [4], author introduced the eenergy efficient data collection framework for wireless sensor networks. Into the RBN encoded data streams for capturing these type of ripple effects of symbol errors the system should have more energy for the data transmission. Instead of conventional bit error rate for the accurate performance analysis here described the frame error rate concept.

In [5], author proposed energy efficient communication scheme for applications based on low power wireless networks, to appear in Proc. 6th IEEE Consumer Communications & Networking. In this system no use of algorithm therefore it directly gives the output in binary form .This system requires more transmission energy at both side i.e is transmitter and receiver.

In [6], author introduced novel energy efficient MAC protocol based on redundant radix for wireless networks. In this system radix based number representation for encoding and transmitting data for application which typically utilized low cost devices. For digit zero communication the system has been grouped along with the silent period.

In [7], another new approach proposed by authors based on the distribution of runs of ones in binary strings, In this system data compression, bus encoding techniques to reduce crosstalk in VLSI chip design, computer arithmetic using redundant binary number system and transformation of runs of one's into compressed information pattern.

In [8], author proposed system based on Energy efficient clustering algorithm. There is the restricted storage space & power into the WSN system. Cluster based data aggregation protocols reduces the latency in the tree based data aggregation by grouping the nodes in WSNs into cluster. There is the restricted storage space & power into the WSN system.

In [9], author proposed novel Data Density Correlation Degree Clustering Method. This system cause energy wastage at aggregator nodes due to the decryption and encryption operations at aggregator nodes for the data aggregation and further secure transmission for Data Aggregation in WSN. This system requires high density power for energy transmission.

In [10], author proposed novel energy-efficient communication scheme called CNS (Compression with Null Symbol) that combines the power of data compression and communication through silent symbol. There method combined power of communication as well as data compression via the silent symbols.

In [11], author proposed new approach of local adaptive data compression technique using the fuzzy transform is designed in order to reduce the WSNs bandwidth, consumption of energy, memory requirements in wireless communications.

III. METHODOLOGY

For observing the dynamic compression necessities at the time of data transmission into the WSN here our proposed system proposes the functionality of the adaptive encoding along with CNS base approach. Figure 1 is showing the proposed system block diagram which represents the compression methods and their comparative parameters.

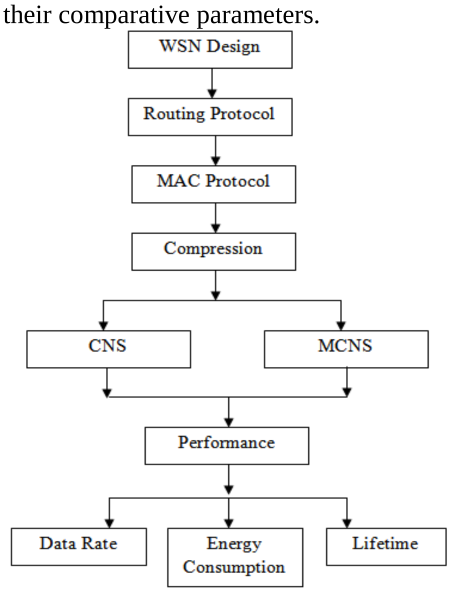

Figure.1. Proposed System Block Diagram

There are three algorithms used to design MCNS method such as transmitter, receiver and adaptive encoding algorithm.

Algorithm 1: Transmitter

procedure CNSTransmit
(**IN bit vector** *data_frame*, **IN integer** *frame_len*)
var *trans_len*: **Integer**;
▶ *trans_len* is half of binary frame length

trans_len
Transmit *trans_len*;
▶ length of CNS data
Determine the *BpSMapping* using either *Scheme 1* or *Scheme 2*;
▶ bit-pair to symbol mapping
Transmit *BpSMapping*;
▶ obtained using either Scheme 1 or 2
for *i* = 0 to *frame_len* **step 2 do**
Determine symbol *sym* to be transmitted based on
BpS Mapping of bits *data_frame*[*i*] and *data_frame* [i + 1];
Transmit *symbol sym*;
▶ Either A, B, C or N
end for
end procedure

Algorithm 2: Receiver

procedure CNSReceive (OUT **bit vector** *recv_data*)
/* *time_slot*[*i*] refers to the i^{th} time slot */
var j: Integer;
▶counter for output buffer *recv_data*
j ←0;
Receive *trans_len* from transmitter;
▶length of the transmitted CNS data
Receive BpSMapping;
▶transmitter first sends the BpS Mapping
for *i* = 0 to *trans_len* **do**
recv_sym←*time_slot*[*i*];
▶received symbol in time slot *i*, either *A, B, C* or *N*
Use received *BpSMapping* to determine output bit-pair, *recv_data*[*j*]
and *recv_data*[*j* + 1] corresponding to symbol *recv_sym*; ▶either 00, 01, 10 or 11
j ←*j* + 2;
end for
end procedure

Algorithm 3: Adaptive Encoding

This algorithm is represented in form of figure 2:

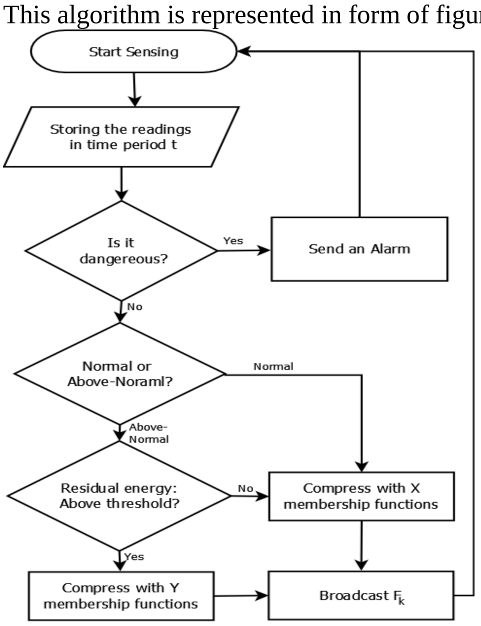

Figure.2. Adaptive Encoding Algorithm 3

IV. RESULTS

The simulation analysis is done using NS2 by considering below network configuration parameters with performance metrics:

- Compress Technique: CNS/MCNS
- Number of Sensor Nodes: 25
- MAC: 802.11
- Varying Data Rate: 10, 20, 30, 40, 50

Outputs:

- Energy Consumption vs. Varying Data Rate
- Network Lifetime vs. Varying Data Rate
- Data Rate vs. Varying Data Rate

Based on above parameters, we measure the results and compare their performance among existing CNS and proposed MCNS technique for energy consumption (showing in figure 4), data rate performance (in figure 3) and network lifetime (in figure 5). The MCNS is outperforms the current method for the energy efficiency data compression in WSN has been shown in our comparative analysis.

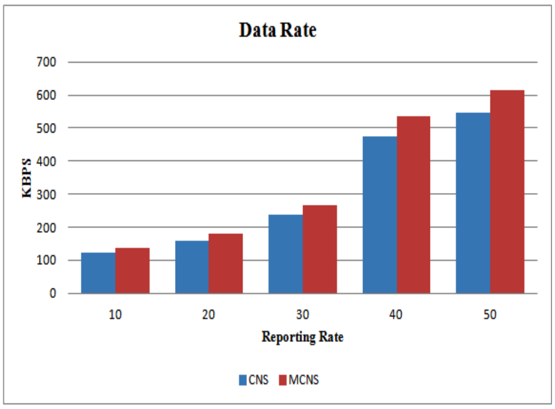

Figure.2. Data Rate Analysis

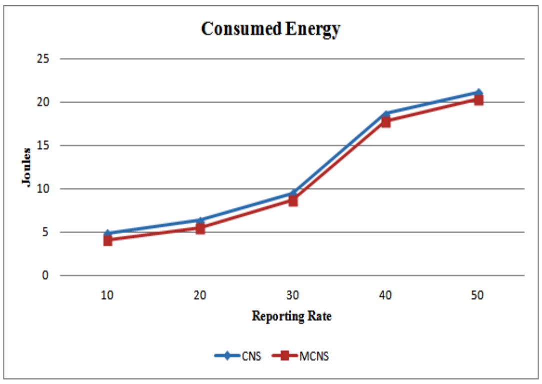

Figure.3. Energy Consumption Analysis

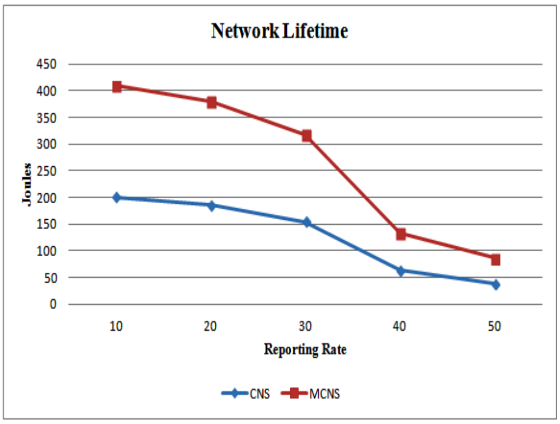

Figure.4. Network Lifetime Performance

V. CONCLUSION AND FUTURE WORK

In this paper, we proposed the efficient technique for data compression for radio networks such as wireless sensor networks. The aim of using data transmission in wireless networks is to minimize the network communication costs such as bandwidth, memory and energy consumption. For WSNs, energy is most constraint resource for sensor nodes; hence there should be the energy efficient method for data communication. So here MCNS technique for the WSN is being implemented & designed by us. The proposed technique has been shown into the performance output the data rate performances & enhanced energy efficiency has been shown that in that proposed technique. For future wok, we suggest to work on network scalability and reliability with consideration of different network conditions.

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