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Review on "A Convolution encoding approval to optimize communication in sensor network"

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Abstract: A sensor network is defined with restricted network constraints and defined in real time network scenario. To optimize the network communication, it is required to improve the communication behaviour or the constraints. In this present work, an encoding mechanism is defined to reduce the communicating information so that the overall network performance will be improved. In this work, an encoding mechanism is defined to improve the network communication in a clustered architecture. The encoding approach will be able to reduce the size of communicating data as well as track the associated errors. The encoding mechanism will be controlled by the cluster head. The cluster head will accept the information from the clustered nodes in the form of encoding bits so that the overall communication rate will be improved. To perform the encoding convolutional encoding mechanism will be applied. The presented work will be implemented in matlab environment.

Keywords: WLAN, WSN, ECC, FEC etc.

INTRODUCTION

A WSN is different from other popular wireless networks like cellular network, wireless local area network (WLAN) and Bluetooth in many ways. Compared to other wireless networks, a WSN has a large number of nodes in a network, also the distance between the neighbouring nodes is much shorter and application data rate is much lower. These are the reasons due to which, power consumption in a sensor network has to be be minimized.

To keep the cost of entire sensor network low, cost of each sensor needs to be reduced. It is also important to use tiny sensor nodes. A smaller size makes it easier for a sensor to be embedded in the environment in which it want to. WSNs may also have a lot of redundant data since multiple sensors can sense similar information. The sensed data therefore needs to be aggregated to decrease the number of transmissions in the network, reducing bandwidth usage and eliminating unnecessary energy consumption in both transmission and reception.
Following are some of the characteristics of a wireless sensor network:

- Typically, a wireless sensor network is composed of nodes that communicate over wireless links without the need for any central control or fixed infrastructure address.
- Each sensor node is an autonomous node i.e. it may function as both a host and a router. So, in addition to the sensing ability as a host, the sensor nodes can also perform switching function as a router.
- Wireless Channels in WSN have relatively high error rate. In WSN high bit error rate is caused due to multipath fading, Doppler shift and signal attenuation.
- Every node has the ability to transmit info for path and the required information to all other adjacent nodes.
- Wireless sensor networks are basically peer-to-peer, multihop mobile wireless networks in which information packets are transmitted in a store-and-forward manner from a source to an arbitrary destination, via intermediate nodes.

ADVANTAGES OF WIRELESS SENSOR NETWORKS

The WSNs has revolutionized the whole world. They are becoming integral part of our lives, more so than the present-day computers because of their numerous advantages which are mentioned below:-

i. **Ease of deployment**
A sensor network contains hundreds or even thousands of nodes and can be deployed in remote or dangerous environments. Since these nodes are small and economical, throwing of hundreds or thousands of micro-sensors from a plane flying over a remote or dangerous area allows extracting information in ways that could not have been possible otherwise.

ii. **Extended range of sensing**
Single macro-sensor nodes can only extract data about events in a limited physical range. In contrast, a micro-sensor network uses large numbers of nodes enabling them to cover a wide area.

iii. **Improved lifetime**
The nodes located close to each other will have correlated data therefore they can be grouped together. Only one of the nodes in a round robin fashion from the group needs to be in active state at any instance of time keeping other nodes in sleep state. It will enhance the network life time.

iv. **Fault tolerance**
In WSN several sensor nodes are close to each other and have data which may be related to each other, which makes these systems much more fault tolerant than single macro-sensor system. The macro-sensor system cannot function if macro-sensor node fails, whereas in case of micro-senor network even if smaller number of micro-sensor nodes fails, the system may still produce acceptable qualitative information since they all are connected to each other.

v. **Improved accuracy**
While an individual micro-sensor's data might be less accurate than a macro-sensor's data but when micro-sensors are connected in the group in that case output of the micro-sensors is very fast. The data from nodes located close to each other can be combined since they are gathering information about the same event. It will result in better accuracy of the sensed data and reduced uncorrelated noise.

vi. **Lower cost**
Even though, to replace each macro-sensor node several micro-sensor nodes are required they will still be collectively much cheaper than their macro-sensor counterpart due to their reduced size, simple as well as cheap circuitry and lesser accuracy constraints. Due to which protocols that enable micro-sensor networks to provide necessary support in sensing applications are becoming more popular.

vii. **Actuation**
Actuation can dramatically extend the capabilities of a sensor network in two ways. First, it can enhance the sensing task, by pointing cameras, aiming antennae or repositioning sensors. Secondly, it can affect the environment – by opening valves, emitting sounds or strengthening beams.

viii. **Collaborative objective**
Perhaps the most important aspect of sensor networks that differentiates them from other wireless networks is their objective. Typically, objective of a sensor network is monitoring a specific signal of interest and informing a central base station or a sink about activities in the region being sensed. Since a sensor network is deployed for achieving a certain system-wide goal, nodes collaborate instead of competing with each other.

Error Encoding Scheme

An error-correcting code (ECC) or forward error correction (FEC) code is a system of adding redundant data, or parity data, to a message, such that it can be recovered by a receiver even when a number of errors (up to the capability of the code being used) were introduced, either during the process of transmission, or on storage. Since the receiver does not have to ask the sender for retransmission of the data, a back-channel is not required in forward error correction, and it is therefore suitable for simplex communication such as broadcasting. Error-correcting codes are frequently used in lower-layer communication, Error-correcting codes are usually distinguished between convolutional codes and block codes:

- Convolutional codes are processed on a bit-by-bit basis. They are particularly suitable for implementation in hardware, and the Viterbi decoder allows optimal decoding.
- Block codes are processed on a block-by-block basis. Early examples of block codes are repetition codes, Hamming codes and multidimensional parity-check codes. They were followed by a number of efficient codes, of which Reed-Solomon codes are the most notable ones due to their widespread use these days. Turbo codes and low-density parity-check codes (LDPC) are relatively new constructions that can provide almost optimal efficiency.

Review of Literature

In year 2006, Juejia Zhou performed a work," A Kind of Application-Specific QoS Control in Wireless Sensor Networks". In the paper, Author define the optimal number of power-up nodes in the focused area as the QoS target. In order to make the optimal number of nodes to power up in the focused area, a modified Gur Game strategy is given. In the strategy, the base station receives the QoS feedback and gives the dynamic domination information including the area shape information and the dynamic gradient parameters

In year 2007, Haifeng Hu performed a work, "The Study Of Power Control Based Cooperative Opportunistic Routing In Wireless Sensor Networks". This paper presents PC-CORP (Power Control based Cooperative Opportunistic Routing Protocol) for WSN (Wireless Sensor Networks), providing robustness to the random variations in network connectivity while ensuring better data's forwarding efficiency in an energy efficient manner. Based on realistic radio model, Author combine the region-based routing, rendezvous scheme, sleep discipline and cooperative communication to model data forwarding by cross layer design in WSN.

In year 2007, Paulo Sergio Sausen performed a work," Energy Efficient Blind Flooding in Wireless Sensors Networks". Author investigate some alternatives to improve broadcasting in WSN for an extended network lifetime. This is accomplished in two ways. First, Author adapt the Dynamic Power Management with Scheduled Switching Modes (DPM-SSM) technique to a blind flooding protocol (i.e., FLOOD). To capture the battery capacity recovery effect as a result of applying DPM , Author consider a more realistic battery model (i.e., Rakhmatov-Vrudhula battery model). Second, Author implement a multi-coverage TC solution for computing an energy efficient broadcast backbone.

In year 2009, Peng Ji performed a work," A Power-aware Layering Optimization Scheme for Wireless Sensor Network". In the scheme, a directed spanning tree routing algorithm is discussed to resolve unnecessary energy consumption during data transmission. Regarded as a key factor, transmission power of node should be controlled to avoid occurrence of communication contention in some hot sub-area. And a Lagrange dual function is designed and iterated in order to find the optimal transmission power of every sensor node.

In year 2009, Parvaneh Rezayat performed a work," A Novel Real-Time Routing Protocol in Wireless Sensor Networks". In this paper Author propose a novel real-time Power-Aware TwoHop (PATH) based routing protocol. PATH improves real-time performance by means of reducing the packet dropping in routing decisions. PATH is based on the concept of using two-hop neighbor information and power-control mechanism. Author analyze PATH and compare it with THVR.

In year 2009, Kritchai Witheephanich performed a work," On The Applicability of Model Predictive Power Control to an IEEE 802.15.4 Wireless Sensor Network". This paper addresses the practical applicability of dual mode infinite horizon model predictive control (MPC) strategies for a variety of stationary and mobile transmission power control problems that arise naturally in wireless sensor network (WSN) systems. The key performance requirement is to maximise battery lifetime while also preserving sufficient Quality of Service (QoS) among all users.

In year 2011, Djamel Djenouri performed a work," Traffic-Differentiation-Based Modular QoS Localized Routing for Wireless Sensor Networks". The proposed protocol can operate with any medium access control (MAC) protocol, provided that it employs an acknowledgment (ACK) mechanism. Extensive simulation study with scenarios of 900 nodes shows the proposed protocol outperforms all comparable state-of-the-art QoS and localized routing protocols.

In year 2012, A. Chehri performed a work," QoS Aware Green Routing Protocol for Wireless Sensor Networks". In this paper Author use an optimization scheme based on adaptive modulation and power control for a green routing protocol. The optimization mechanism is subject of certain QoS requirement in term of total end-to end delay time and bit error rate.

In year 2012, Prof. Arun Biradar performed a work," Dual Channel Based Multi-Objectives Genetic Routing Protocol for Ad-Hoc Networks and Optical Networks Using Power Aware Clustered Topology". In order to find a possible solution space usage of natural searching techniques like genetic algorithms is used. To optimize the issue of dynamic topology power aware cluster selection and reorganization is proposed.

In year 2012, Nirmala.S, Nallusamy.R performed a work, "An Energy-Efficient and enhanced QoS aware of MAC application specific protocol in the distributed Wireless Sensor Networks". This paper presents an energy-efficient aware of MAC application specific protocol with enhanced, integrated type in the distributed environment. The proposal concentrates to point out and identifies the key problems of distributed MAC algorithm.

In year 2013, Mohammad Arifuzzaman performed a work," An Intelligent Hybrid MAC With Traffic-Differentiation-Based QoS for Wireless Sensor Networks". In this paper, Author present the Intelligent Hybrid MAC (IH-MAC), a novel low power with quality of service guaranteed medium access control protocol for wireless sensor networks (WSNs).

In year 2012, Diogo F. Lima Filho performed a work," TCNet: Trellis Coded Network - implementation of QoS-aware routing protocols in WSNs". This work proposes to implement the new concept of a "Trellis Coded Network"-(TCNet). This model uses Mealy machine-(MM) or low complexity Finite State Machine (FSM) network nodes ("XOR" gates and shift registers), eliminating the use of any routing tables by means of Trellis decoding.

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In year 2013, Irfan Al-Anbagi performed a work," An Adaptive QoS Scheme for WSN-based Smart Grid Monitoring". In this paper, Author present an adaptive Quality of Service (QoS) scheme for WSNs that provides service differentiation by reducing the delay of critical data in smart grid monitoring and control applications. This scheme is tailored for large-scale WSN deployments with multi-hop cluster tree topologies.

In year 2013, Luıs Marques performed a work," Fighting Uncertainty in Highly Dynamic Wireless Sensor Networks with Probabilistic Models". Author argue for, and show the efficacy of, using probabilistic models to characterize dynamic WSN QoS, which is the first step to tackle the problem head on. Using Presented network monitoring technique, Author demonstrate that it is possible to meet probabilistic real-time objectives.

In year 2012, R. Valii performed a work," Power Control with QoS constraints in WSN using Game Theoretic Approach". This paper propose s a power control game with error control coding (ECC) while considering the QoS requirement s. The performance of the power control game satisfying QoS delay constraints with Reed Solomon (RS) and Multivariate Interpolation Decoded RS code (MIDRS) code for WSN is evaluated in term s of bit error rate (BER), throughput and de lay.

T. T. Kadota describes convolutional code as a type of error-correcting code in which each k-bit information symbol (each m-bit string) to be encoded is transformed into an n-bit symbol, where k/n is the code rate ($n \geq k$) and the transformation is a function of the last m information symbols, where l is the constraint length of the code. Convolutional codes are used extensively in numerous applications in order to achieve reliable data transfer, including digital video, radio, mobile communication, and satellite communication.

Richard D. Wesel describes Convolutional encoder which is used to obtain convolution codes. It take a single or multi-bit input and generate a matrix of encoded outputs. In digital modulation communications systems noise and other external factors can alter bit sequences. By adding additional bits we make bit error checking more successful and allow for more accurate transfers. By transmitting a greater number of bits than the original signal we introduce a certain redundancy that can be used to determine the original signal in the presence of an error.

Significance of Work

The significance of work is given as

- The convolutional encoding scheme will convert the n size data block to m size data block where m<n, so that the lesser energy will be consumed during transmission.
- The constraint specific encoding scheme will be able to perform error correction so that the bit error rate will be reduced.

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