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A Proposed Method to Enhance the Quality of Data Communication in WSN using Modular Arithmetic

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Abstract: ***Wireless sensor networks (WSN) are the current direction to monitor the resources and processes by developing fault tolerant distributed auto configure systems. High reliability is required to use WSN in safety systems, real time monitoring systems, guard systems and industrial control for all levels of the OSI model. To eliminate the noise and to process the information parallel by extending the signal spectrum using FHSS and Residue number system (RNS) based transformation. These approaches increase the reliability of data transmission in a WSN physical layer only. It is essential to have reliable data transmission in the network layer. When network topology is modified, packet loss is caused by overload and emergency or inaccessibility of units. Delay time increases because of packet retransmission. These considerations have led us to propose to work on "Performance studies on RNS based spread spectrum techniques for few communication channels"***

Keywords: ***RNS, WSN, RRNS, RSNS, IGRSNS***

I. INTRODUCTION

We have chosen Residue Number System for error control [7][8]. Number theoretic transforms (NTT) based a set of detection and correction of error codes is available [1][6]. One exemplary example of NTT is RNS. RNS was invented by Sun Tzu a Chinese scholar in the third century. In the 1950s, computer scientists rediscovered RNS, which leads them to implement the computing of speedy arithmetic and fault-tolerant operations. Implementation of parallelism in digital hardware is based on the modular structure that RNS-based arithmetic has [9][10]. The RNS has three built-in features which are useful and attractive which go against to usual weighted number systems, like representation of the binary weighted number system. The first feature is the non-appearance of carry-propagation w.r.t addition and multiplication, as propagation of carry is the notable factor in these operations that limits the speed. The Second feature is, an error in any position of the digit does not affect other positions of the digit and also carry no information on weight in a given residue representation.

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And very importantly the third feature is that instead of a reduction in dynamic range the faulty digit positions may be rejected and also an RNS representation has no specific sequence of digits.

II. REVIEW OF RESIDUE NUMBER SYSTEMS

RNS are widely engaged in correction and detection of errors in transmitting data, arithmetic operations and digital system processors [15]. Some of the applications of RNS in this field are briefed below. The residue number system transforms (RNST), which is used to transform any conventional weighted number systems to RNS and the inverse RNST (IRNST) algorithm, transforms the RNS to the weighted number system, is defined in [2], which is importantly needed to convert the operands of the one system to the other. Multi-carrier CDMA (MC-CDMA) system bandwidth efficiency may increase with increasing the number of bits per symbol [3]. To enhance the efficiency of bandwidth by implementing parallel transmission of data bits, stable chip rate and also number of sub-carriers with orthogonal spread codes (multi-coded MC-CDMA systems) [4]. If there is possibility in the number of maximum orthogonal sequences leads to the decrease in achieving the efficiency of bandwidth in a system. RNS based Multicarrier CDMA systems are another method to improve the efficiency of bandwidth with lower bit-error rates by increasing the transmission of a number of bits per symbol [3].

Ultra wideband System (UWB) is an alternative design for using narrowband signals are surveyed in [5] based on frequency-hopping (FH) spread-spectrum multiple-access techniques [11]. RNS arithmetic properties recommend the redundant residue number systems (RRNS) which is used in correction and detecting errors and also self-checking in digital processors. RNS is designed using redundant moduli for the purpose of data protection and representation, that is the reason this system has the competence of self-searching and scrutiny, error-correction and error-detection [2]

The robust symmetrical number system (RSNS)[15] explains that at most one element changes between transitions of code in each RSNS vector. RSNS is used in the conversion of analog data to digital (ADC), radio direction finding and electro-optical ADCs reason being it removes all the errors related to encoding which occurs when the input signal lie down in which ever transition point of the code due to theinteger Gray-code property RSNS has.

Gray code properties of RSNS are particularly attractive for error control [13]. The modular number system, i.e. RSNS [6], within each modulus (comparator states) integer values (residues) each change one position at a time at the next code position (integer Gray code properties) in [12].

To control errors, a novel NTT is proposed i.e., Inverse Gray Robust Symmetrical Number Systems (IGRSNS) in [6]. IGRSNS is designed by adapting Robust Symmetrical Number System (RSNS) which has the Inverse Gray code property. This proposed system enhances the probability of detecting errors using RSNS. Inverse Gray is a coding technique where mapping is inversely related to the Gray code. Two successive integers differ by one bit in gray code, i.e., Hamming distance is 1 for two successive integers. Two consecutive k-bit integers differ by $k - 1$ bit in inverse gray. That is say; the only single bit is holding on in every switching between integer m and m±1. This focus explains or understands to construct a number of ways of inverse Gray codes where ever necessary to maintain one same bit in the code and change the remaining in the course of transition between two successive integers. In [6], a novel technique to generate Inverse Gray code and an algorithm to encode and decode Inverse Gray code is presented. Also, an algorithm is presented for the generation of a unified code for both Gray code and Inverse Gray code. The proposed algorithm reduces the number of gates required to generate Inverse Gray code.

III. PROPOSED WORK

The proposed method of multi-path routing is to use coding based on Residue Number system. Use of multi-path routing is the most effective method to improve the reliability of data-transmission in the network-layer of WSN [14]. Multiple paths are computed per each address, thereby facilitating increase in the overall service capacity. Multipath routing provides an effective mechanism to increase the probability in delivering reliable data for the account of submitting a few data duplicated by different routes. Usage of multipath routing protocols may increase energy costs and network traffic. One of the better approaches is implementing data sharing algorithm and transmission by different routes. Data packet sharing algorithm is also called as Threshold Scheme. The use of existing Threshold Schemes allows reconstructing data, but at the same time, use of distorted message parts may counteract with the data burst re-construction. Therefore, the improved method of data burst sharing in WSN is based on Residue Number System. After the WSN unit activates the data transmission and determines accessible non-intersecting routes for the transmission, it is required to evaluate the effectiveness per each route. Depending on the number of accessible routes, it is required to select the number and values of mutually simple modules. As a result, the information divided on the selected modules we get residues, which are transmitted by previously determined routes. Bigger residues are transferred by the best quality routes and vice-versa. This permits improvements with respect to correcting possibilities of RNS based codes and thereby increasing the transmission reliability. In the proposed work, RNS based coding scheme, a method of message sharing and shortest path calculations for multipath routing algorithms are considered. Multipath routing algorithm under consideration is for static sensor nodes as well as to support nodes with limited mobility and shall be data centric and application-aware.

IV. CONCLUSION

To improve the data transmission reliability, by using spread spectrum methods like Direct Sequencing Spread Spectrum (DSSS), Frequency Hopping Spread Spectrum (FHSS) along with Cyclic Redundancy Check (CRCs), based on binary and non-binary cyclic error correcting codes. Extending the signal spectrum by FHSS and transformation based on residue number system enables to implement the code for eliminating noise and the parallel information processing.

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