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RESEARCH ARTICLE

A Game Theory Improved Encoding Mechanism for Reduction of Error rate

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ABSTRACT:-
To provide the safe and secure communication, there are number of preventive and detection approaches applied over the network. One of such approach called encoding mechanism is improved in this work. The work is here performed on convolution encoding to provide the safe transmission between node pair. The presented work is divided in two stages. In first stage, game theory is applied to analyze the communication. If the communication is critical, the encoding mechanism is applied over it to secure the information. The obtained results show the effective reduction in error rate over the communication.

Keywords: Game Theory, Data Encoding, Convolutional Codes, Secure Transmission

1. Introduction

Communication over the network is performed to achieve the information transmission under specific route. As the communication is performed over the route and energy specification. One of the major requirements of this communication network is the safe information transmission. There are number of approaches to perform the safe communication over the transmission. Several schemes exist to achieve error detection. The general idea is to add some *redundancy*, i.e., some extra data, to a message, that enables detection of any errors in the delivered message. Most such error-detection schemes are *systematic*: the transmitter sends the original data bits, and attaches a fixed number of *check bits*, which are derived from the data bits by some deterministic algorithm. The receiver applies the same algorithm to the received data bits and compares its output to the received check bits; if the values do not match, an error has occurred at some point during the transmission. In a system that uses a "non-systematic" code, such as some raptor codes, the original message is transformed into an encoded message that has at least as many bits as the original message. In this paper, the routing approaches and the encoding mechanism are discussed.

A) Unicast Routing

Unicast routing is about the generation of single path between single source and destination node. The challenge in such routing is to obtain the QoS while performing the effective utilization of bandwidth and the buffer space. The state path generation under the bottleneck problem is also a challenge for communicating network. Unicast routing is also 1, which is the bandwidth of the bottleneck link (i, j). For these QoS metrics, two basic routing problems can be defined. One is called link-optimization routing. An example is the bandwidth-optimization routing, which is to find a path that has the largest bandwidth on the bottleneck link. Such a path is called the widest path. The other problem is called link-constrained routing. An example is the bandwidth- constrained routing, which is to find a path whose bottleneck bandwidth is above a required value [2].

For other QoS metrics such as delay, delay jitter and cost, the state of a path is determined by the combined state over all links on the path. For example, if the delay of path s → i → j → t is 10, which is the total delay of all links on the path. Two basic routing problems can be defined for this type of QoS metrics. One is called path-optimization routing. An example is the least-cost routing, which is to find a path whose total cost is minimized. The other problem is called path-constrained routing. An example is the delay-constrained routing, which is to find a path whose delay is bounded by a required value. [2].

The next process of the system is to perform the channel coding. In this work we have defined three different encoding schemes are discussed in section II.

2. ENCODING SCHEMES

A convolutional code is a type of code in which each k-bit information to be encoded is transformed into an n-bit symbol. A convolutional code introduces redundant bits into the data stream through the use of linear shift registers as shown in (Figure1). The inputs to the shift registers are information bits and the output encoded bits are obtained by modulo-2 addition of the input information bits and the contents of the shift registers.

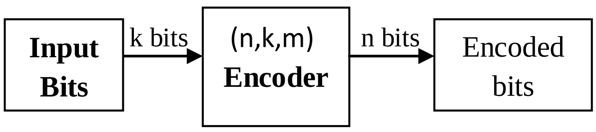


Figure 1: Encoding Mechanism

A) Convolution Code Encoder

A convolutional encoder is made up of a fixed number of shift registers. Each input bit enters a shift register and the output is derived by combining the bits of the shift register. The number of output bits depends on the number of modulo 2-adders used with shift registers**.**

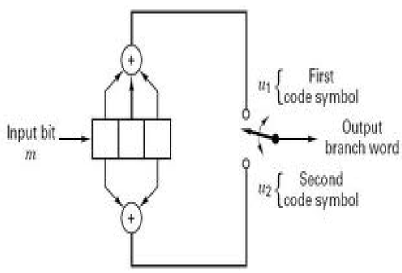


Figure 2: Convolution Code Encoder

Convolutional codes are primarily described by three parameters (n,k,m) where,
n = number of output bits
k = number of input bits
m = number of memory registers

A convolutional encoder is characterized by two parameters, namely code rate (r) and constraint length (K). The code rate is defined as the ratio of the number of message bits(k) to the number of encoded bits (n).

r = k/n

The convolutional code's structure is easy to draw from its parameters. First draw m boxes representing the m memory registers. Then draw n modulo-2 adders to represent the n output bits. Now connect the memory registers to the adders using the generator polynomial.

This is a rate 1/3 code. Each input bit is coded into 3 output bits. The constraint length of the code is 2. The 3 output bits are produced by the 3 modulo-2 adders by adding up certain bits in the memory registers. The selection of which bits are to be added to produce the output bit is called the generator polynomial (g) for that output bit. For example, the first output bit has a generator polynomial of (1,1,1). The output bit 2 has a generator polynomial of (0,1,1) and the third output bit has a polynomial of (1,0,1). The output bits just do the sum of these bits.

$$v_1 = \text{mod2}\,(u_1 + u_0 + u_{-1})$$

$$v_2 = \text{mod2}\,(u_0 + u_{-1})$$

$$v_3 = \text{mod2}\,(u_1 + u_{-1})$$

The polynomials give the code its unique error protection quality.

B) Hamming codes

Hamming codes are block codes, so coded vectors, *c*, of length *n* coded bits are formed from a data sequence, *d*, of length *k* information bits, and generator matrix, *G*, as follows:

[c] = [G] [d].

*n*x1 *n*x*k* *k*x1

There are specific possible sizes of *G* for hamming codes based on a parameter, *m*. $n = 2^m - 1$, $k = n - m$. So, for m = 3, n = 7 and k = 4. This is called the (7,4) Hamming code.

C) RS Encoding

Reed Solomon encoding is a block encoding scheme. The system implemented in this study was a (255,223) system, in which (*n*,*k*) denotes an output codeword length of *n* and an input word of length *k*, as shown in *Figure 1.* It has a symbol size**,** *s*, equal to 8. The decoder has a correcting capability of *t* symbol errors in the code word, with $n - k = 2t$, in this case, $t=16$.

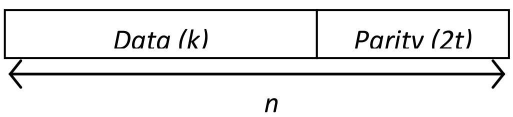


Figure 3 : typical RS codeword

The encoder forms a code word $x^{n-k}m(x) + r(x)$ by means of the following equation:

$$\frac{x^{n-k}m(x)}{g(x)} = q(x) + \frac{r(x)}{g(x)}$$

The divisor, *g(x)* is known as the generator polynomial. It is a polynomial of degree *(n-k)* and which is a factor of (x^n+1). To maximize the minimum distance between codes, the roots of this polynomial should all be consecutive. This is a direct consequence of the BCH bound, which states that the minimum distance is always larger than the number of consecutive factors of *g(x)*. The system used adapted a generator polynomial with roots from α^1 to α^{32}.

3. PROPOSED APPROACH

When the communication is performed, to provide the effective transmission, a node performs the transmission by using at high power specification. This high power transmission guarantees the successful delivery of the packet but it consumes energy more than average. Because of this, the energy consumption in such network increases and the QOS services degrades. To perform the transmission with minimum power specification is one of the major challenges in sensor network. To perform this power control, some encoding mechanism is required that will reduce the size of communicating data as well as control the communication error. These encoding schemes are combined with some communication parameter to improve the effectiveness of communication. In this present work, a constraint specific encoding mechanism is suggested to perform effective communication. Coding techniques create code words by adding redundant information to the user information vectors. The convolutional codes takes advantage of the relativity between code blocks, so they have better error correction performance and are used widely. One of such encoding mechanism is convolution encoding. Convolutional codes with longer constraint lengths are widely applied in domains such as satellite communications and digital video. Encoding algorithms generates the code word, which transmitted over the channel. Convolutional code accepts a fixed number of message symbols and produces a fixed number of code symbols. In this work, the convolutional codes will be applied in sensor network to reduce the communication data size and to provide the safe communication.

The energy optimization is one of the major requirement of a sensor network. When the communication is performed in such network, generally it is performed on high power specification so that the reliable communication will draw. But this high power consumption reduces the life of a node as well as of network. The coding scheme is the major phenomenon to perform the reliable encoded data communication over the network. This will reduce the data size as well as provide the error robustness. The work will reduce the power consumption during transmission as well as provide the communication with lesser error.

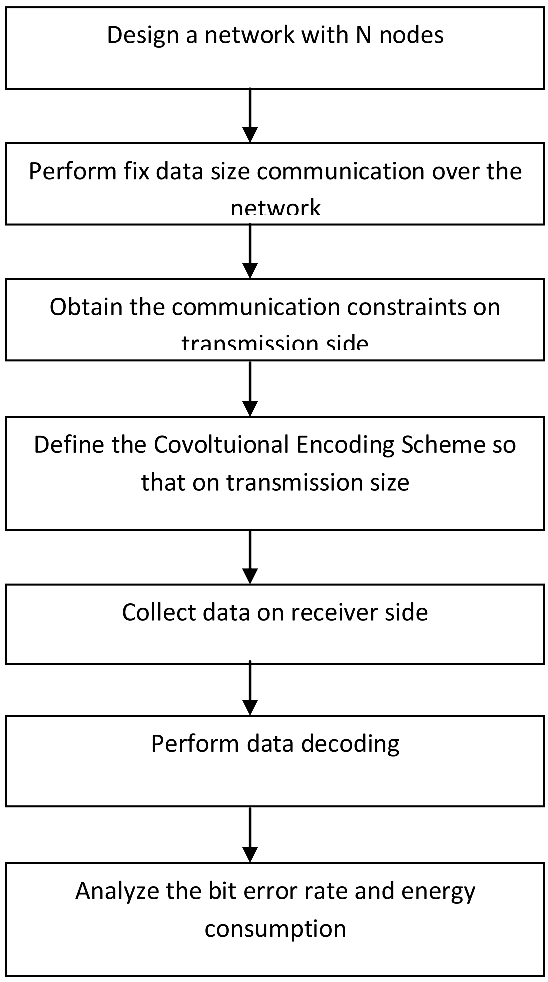


Figure 3 : Work Flow

4. RESULTS

In this section, the results obtained from the work are presented and discussed. The work is implemented in matlab environment. The results are here shown under

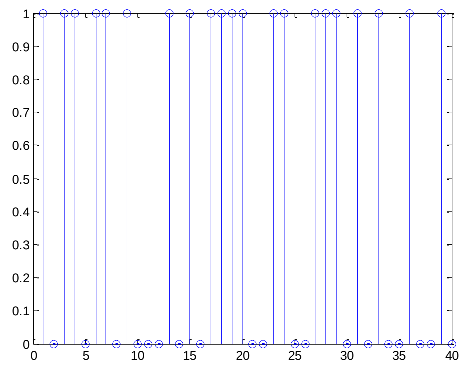
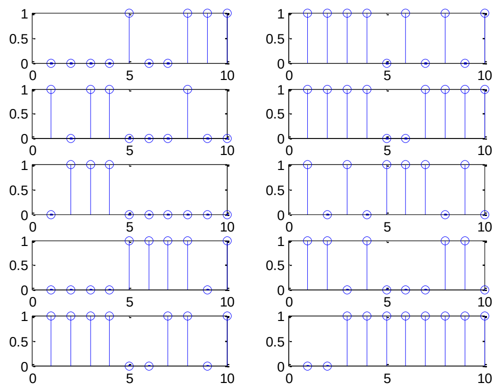


Figure 4 : Communication Bits

Here figure 4 is showing the bit communication over the network. The lines are showing the data value 0 and 1 transmitted over the network.



Here figure 5 is showing the block wise information transmission. Each block is defined with 10 data bits.

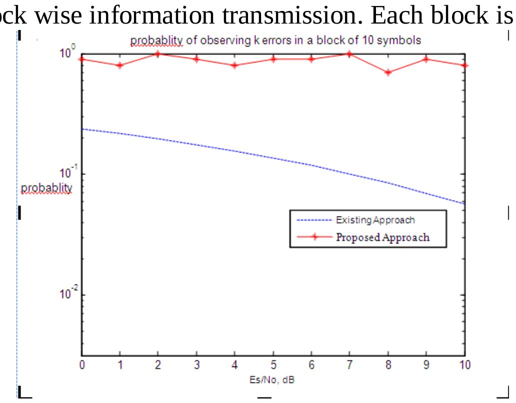


Figure 5.10: Probability of Error Detection in 10 Symbols System (Existing Vs. Proposed)

As we can see in figure 5.10, the X-Axis represents the Error in the channel and Y axis represents the probability of detection of error. As we can see the detection chances of error is somewhat decrease in case of existing approach but the proposed system gives the better ratio of error detection chances.

5. CONCLUSIONS

In this paper, an improved encoding mechanism is defined to reduce the error rate and providing the safe information transmission over the network. The work is applied to improve the convolution encoding mechanism.

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