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A Novel Approach for Error Detection using Double Redundancy Check

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ABSTRACT

In the data communication system where the data is transmitted from one entity to another, there is always a chance of error in the data, which may leads to the distortion of the data. The error can emerge in both analog and digital system. The error is due to certain impairments occurring in the transmission medium. In this paper a simple error detection technique is proposed by which errors of multiple kinds can be detected in a digital communication system. This method is dependent on two simple checks i.e. parity check and sum of the bits being transmitted. The parity check is carried out horizontally and the sum is carried out vertically. The parity even/odd and the sum is appended with the bits being transmitted. Same procedure is carried out at the receiving end and the data if corrupted can be detected. This proposed technique is compared with the existing methods for example Vertical Redundancy Check (VRC) , Longitudinal Red Check (LRC) and Checksum for the evaluation of accuracy. This paper also discusses the shortcomings of the proposed method.
KEYWORDS: Error Detection, Vertical Redundancy Check (VRC), Longitudinal Red Check (LRC), Impairments.

1 INTRODUCTION

In the data communication system where the data is transmitted in the form of binary bits the error occurs when one bit e.g. 1 is changed to 0 or vice versa. This error is due to the transmission impairments present in the medium. Due to the change in only a single bit the whole data is destructed. Generally two types of errors often occur one is "single bit" and the other is "burst error". In single bit error one bit is changed regardless of the other bits. But the burst error is quiet swear, as it involves the disturbing of many bits simultaneously. In burst errors it is not necessary that the bits being changed are next to each other they can be anywhere in the string of data. Single bit error occurs rarely whereas burst errors occur more frequently with high probability.

There are many methods being used for error detection. Some of the famous and most common methods are VRC, LRC, CRC, checksum and 2D parity Check. In LRC method we organize the data in the form of rows and columns and then parity of each column is calculated which is called the LRC, then this LRC is appended with the code and is transmitted. This technique falls when two bits in a column are interchanged. In VRC method a parity bit is appended with the data so that the number of 1s become even including the parity bit. This method falls when the numbers of even bits are interchanged. In Checksum method sum of the bytes of the data is appended after taking 1s complement. This method falls when the changing bits balance each other and the receiver gets the same bits attached with the data. In 2D parity Check we append parity of each row and columns by counting number of 1's. Then we transmit this parity with the data bits so this method takes more redundancy bits.

The principle point of the present exploration work is to make the probability of the incorrect data for the receiver very low. The detection technique involves the function of the bits being transmitted. The code is appended with the transmission bits and sent to the receiver. The receiver perform the same check which was conducted on the transmission side and compare it with the bits affixed with the data. Comparison of this technique with the other existing technique is also carried out to check the performance of this method. This method can detect those errors which other methods fail to detect. The block diagram of this method is shown in Figure 1.

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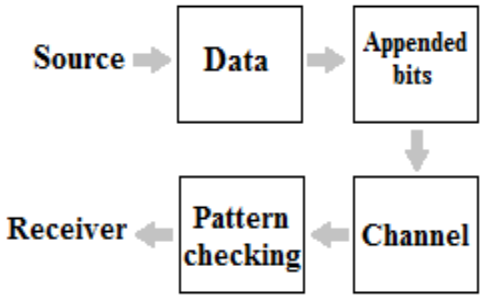

Figure 1: Block diagram of Double Redundancy Check.

2 METHODOLOGY

In this section we discuss about the working of this error detection technique. Contents on both sides i.e. transmission and receiving side will be discussed.

2.1 Transmission side

Consider a string of binary data to be sent. Divide the data into the segments of 8 bits or 1 byte, if the length of the string is not 8 bit append extra zeros on the most significant bits to make it in an appropriate form.

Count the numbers of 1s in each row and assign a parity to each row i.e. 1 for odd numbers of 1 and 0 for even numbers.

Sum the column wise entries of the given string of data and add the parity generated above, with the sum.

Append this sum with the data being transmitted as presented in Figure 2 (a).The appended bits are also known by the receiver.

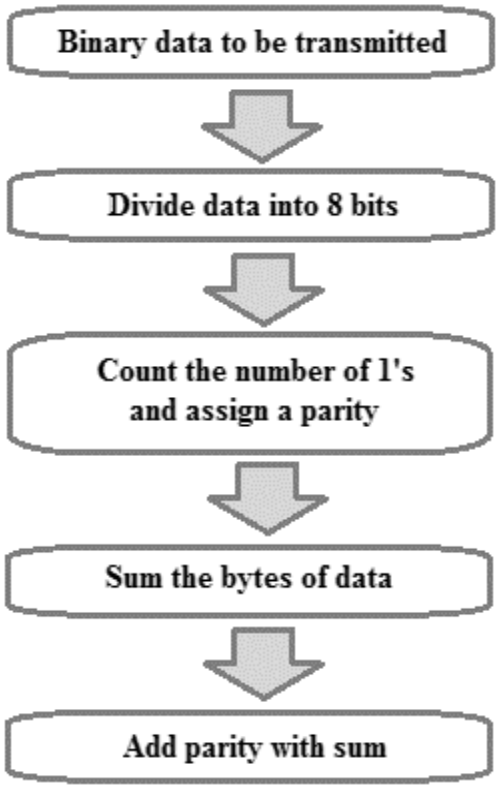

Figure 2 (a): Shows the basic block diagram of the transmission side

2.2 Receiving side

After passing the data through the channel the data is received by the receiver. The receiver separates the data from the appended bits and then perform the same procedure i.e. counts the numbers of 1s in each row of the data and assign a parity to it. Sum the column wise entries of the data received and add this sum with the parity produced during row wise operation

The receiver then compares his result with the code tagged during transmission as shown in figure 2 (b).

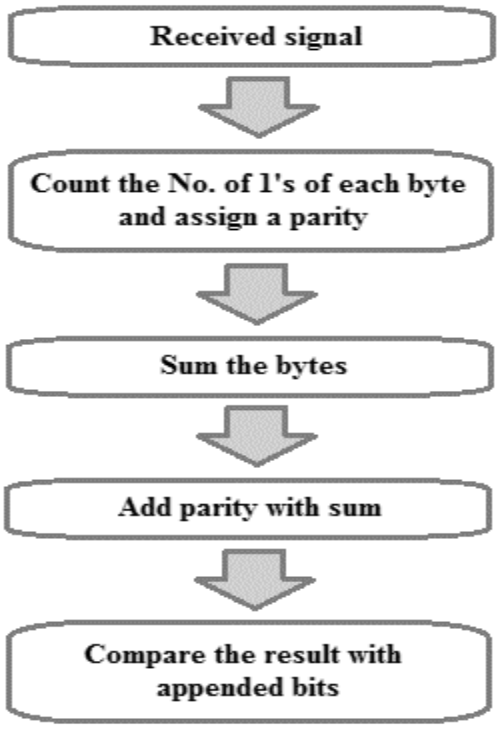

Figure 2 (b): Shows the basic block diagram of the receiving side.

3 Procedure

Let us consider a data of 16 bits length. We divide it first into two segments 8 bits of each. Count the number of ones on the first string and assign a parity to it.

Similarly count the number of ones of the second string and assign a parity to it. Now add the two strings column wise. NOTE: During addition if carry occurs, discard it. Now add the two parties generated above with the sum. Record your result and affix a name to it as shown in figure 3.

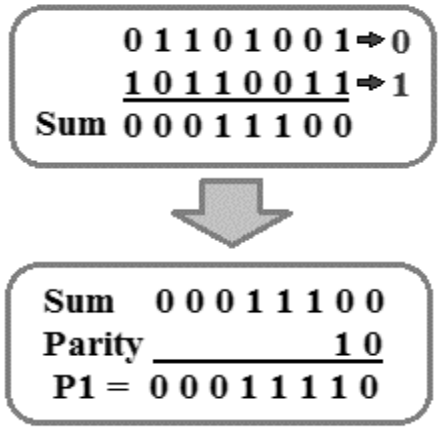

Figure 3: Shows the procedure of Double Redundancy Check

4 RESULTS

We shall now generate errors of different types i.e. Single bit error, Two bit error, Burst error and test it on the given data. Figure 4 shows the graphical view of the data to be transmitted and the redundancy bits.

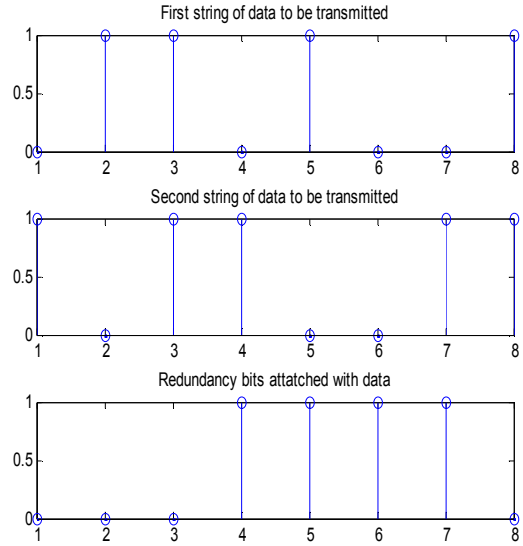

Figure 4: Shows the graphical view of the data to be transmitted.

4.1 Single Bit Error

Generate an error of 1 bit at any location of any string. Let say place an error on the 4th location of the first string and repeat the procedure. Compare your result with the redundancy bits generated in figure 4. You will notice that your result is not same as the result shown in figure 4 which indicates that error has occurred. Graphical view of the detection of single bit error is given below in figure 4 (a).

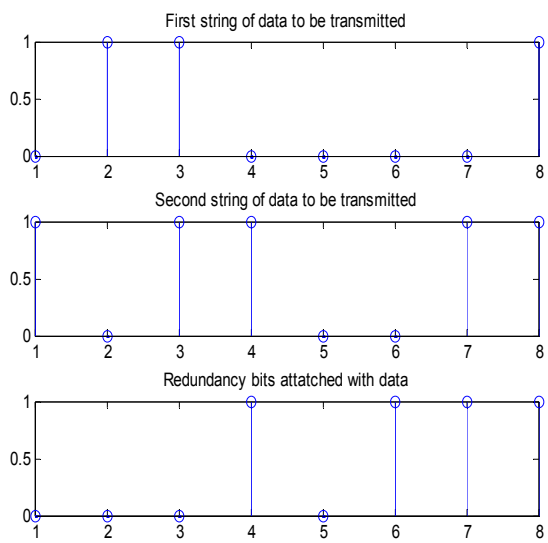

Figure 4 (a): Shows the graphical view of the detection of single bit error.

4.2 Two Bit Error

Till now we have discussed about one bit error but what if the error is more than one bit? Considering this we shall now generate an error of 2 bits. Change one bit on the 4th location of first string and the other on the 4th

location of the second string and repeat the same procedure and compare your result with the redundant bits shown in figure 4. You will notice that your result is not same which indicates that error is detected. Graphical view of the detection of two bit error is given below in figure 4 (b).

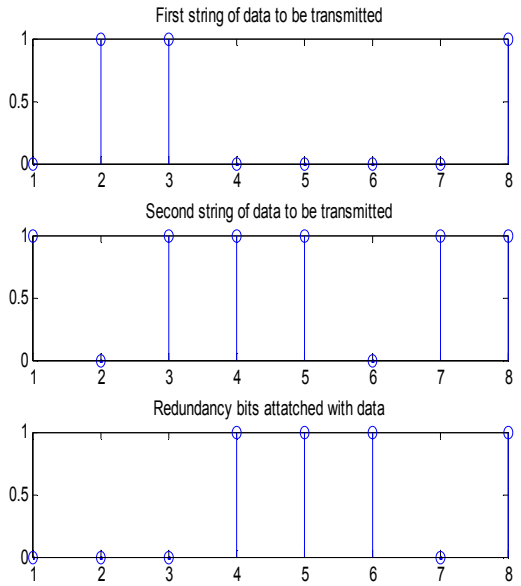

Figure 4 (b): Shows the graphical view of the detection of two bit error.

4.3 Burst Error

After the discussion of one and two bit errors we will now emphasize on the Burst error. Such error can destruct the whole data. Although the probability of this error is comparatively low but still there is a good chance of occurring. Burst error occurs when many bits are changed simultaneously. In the data given above generate a burst error. Make changes in the bits of 2nd 3rd 4th and 5th location of the first string and 4th location of the second string. Repeat the procedure and compare your result with the redundant bits shown in figure 4. Now you will see that your results are not same and hence a burst error is also detected. Graphical view of the detection of two bit error is given below in figure 4 (c).

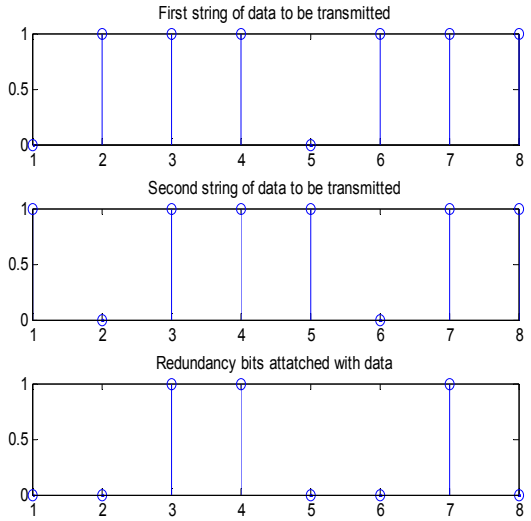

Figure 4 (c): Shows the graphical view of the detection of burst error.

5 DISCUSSION

From the above procedure we have noticed that this technique is helpful in detecting different types of errors. Moreover it also covers the shortcomings of some existing error detection and correction techniques. For example the CRC method perform operation by division method. For a long message string it requires more time to compute its result which reduce the efficiency of the system. In Checksum method, for a long message string it requires more redundant bits to calculate its result. Which will acquire more time for computation and also checksum is unable to detect the error when the two bits on different strings toggle, toggling of even bits in LRC technique also fails to detect the error.

This method is reliable because it is composed of basic arithmetic operations and require less time to compute the result. Data of any length can be entertained by this technique. This method is quiet efficient in the detection of burst errors which occur more frequently in the communication systems. Comparison of double redundancy check with some of the famous methods is given below in the table 5.

Method name	***Original data***	***Corrupted data***	***Error detection***
VRC	01101001	01110001	NO
LRC	01101001 10110011	01101011 10110001	NO
Checksum	01101001 10110011	01101011 10110001	NO
DRC	01101001 10110011	01101011 10110001	YES

Table 5: Shows the comparison between different techniques.

6 Shortcoming

Double Redundancy method is authentic for many types of errors as it removes the drawbacks of many other techniques but it has also a shortcoming.

When the two bits are changed in a row in such a way that they are balanced by the two bits of the other row. Then this method fails to detect the error.

7 Conclusion

There are many methods present for the error detection and correction. Every method has its own advantages and disadvantages. The efficiency of these methods are different from each other.

In this paper a simple error detection technique is proposed, efficiency of which is calculated on different types of errors i.e. single bit error, two bit error and burst error and results are verified with the help of examples. A comparison between this method and other error detection techniques is also carried out. Shortcoming of this method is also examined.

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