Certain Investigation on Error Detecting and Correcting Codes in Memories

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Abstract— The radiation in the space environment creates multiple upsets in the memories, when the datas are travelling from one system to another system. These upsets can become a serious problem in terms of accuracy and performance of the digital system. The reliability of data transmission gets severely affected by these errors.so it is essential to detect and correct the errors and protect the memories from data corruption. The various Error detecting and correcting codes are used to detect and correct the upsets.

Key words: Error Detection (ED) and Error Correction (EC), Multiple Upsets, Decimal Matrix Code

I. INTRODUCTION

Error occurs when output message is not same as input message. Error otherwise called as noise. When the datas are transmitting from one system to other system, noise will occur. That means logic 0 may change to logic 1 or a logic 1 may change to logic 0. The error is detected and corrected by detector and corrector.

A. Error Detecting Codes:
The additional information added to a given message, it is used to detect the error; such information is called an error-detecting code.

B. Error Correcting Codes:
The error correcting codes are used to correct the Error information at the receiver side.

II. COMPARISON OF VARIOUS ERROR DETECTING AND CORRECTING CODES

A. Decimal Matrix Code:
The DMC method[1] is one of the type of Error detecting and correcting code. It is combination of decimal integer adder and decimal integer subtractor. This combination is used to detect and correct errors. Encoder reuse method is used to reduce the extra circuits,because DMC encoder side is used in DMC decoder. It requires very low area, power and delay. The DMC method is maximum memory reliability. It is high fault tolerant capability.In the DMC method information bits are split into rows and columns. Here horizontal bits and vertical bits are calculated.

B. Read Solomon Code:
RS code [2] is also one of the type of error-correcting code. It is used to correct multiple errors. The RS code is RS(n1,k1). A symbol has s bits. n1 is the number of symbols and it is used to store messages is k1. The number of protected information bits is s x k1. The (n1 – k1) are the extra symbols. The RS codes are finite-field arithmetic. By using oversampling method n1 symbols create from k1 symbols , and use interpolation techniques at the receiver to recover the original message. Reed–Solomon codes used in space communication, consumer electronics like DVD,CD, ATSC. RS code decoding algorithm is very difficult.

C. Hamming Code:
A Hamming code[3] is one of the method of linear error detecting and correcting code. It detects more error but it corrects only one error. By using EXOR gates we can calculate the parity bits. The parity bits is otherwise called as redundant bits or extra bits. These bits are combine with an original information bits, and then bits are transmitted. In Hamming code ,mainly two problems were occur, when we increasing the minimum distance,rate of code also increasing .so parity bits were overlap and difficult to manage the system. It consumes more area, power and delay.

D. Matrix Code:
Matrix code[4] is one of the type of error detecting and correcting code. It is mixing of Hamming code and parity checking code. This used to improve the memory reliability. It is used to detect and correct the both single cell upsets and multiple cell upsets. The information bits are divided based on matrix format. The matrix method means divide the information bits into rows and column. By using the matrix method, memory reliability is very high and fault tolerant capability is also very high. It consumes very low area, power, delay. This matrix code is used in various applications like space environment.

E. Punctured Difference Set:
A logic detector/decoder is used as a difference set cyclic code. The PDS[5],[6] has the very high error correction. The Encoding andDecoding side are very easy to implement in Hardware. The error detection is simple way in PDS by using parity check sum method. The code length is N=22S+2S+1 and minimum distance is 2S+2. In PDS we detect the more than one errors. This is the main advantages in PDS. This improves the performance of the memories. The error detecting module is independent of code size, hence the area overhead is less compared with the syndrome fault detection.

F. Reed–Muller Code:
Reed–Muller code [7] is a class of linear error detecting and correcting codes. It is used in various communications applications. Reed–Muller codes is the classes of testing codes and decoding codes, which is useful in the design of probabilistically checkable proofs in computational complexity theory. The Reed–Muller codes is mixing of the Hadamard code, the Walsh–Hadamard code, and the Reed–Solomon code. Reed–Muller codes are listed as RM(d1, r1), where d1 is the order of the code, and r1 determines the length of code, n = 2 r1. The Reed Muller code consumes very high area, power and delay. The memory reliability is very low and low fault tolerant capability.
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<table>
<thead>
<tr>
<th>EC &amp; ED Codes</th>
<th>AREA(µm²)</th>
<th>POWER (Mw)</th>
<th>DELAY(Ns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMC</td>
<td>1,160</td>
<td>84</td>
<td>2.362</td>
</tr>
<tr>
<td>RS CODE</td>
<td>10290</td>
<td>120</td>
<td>7.33</td>
</tr>
<tr>
<td>HAMMING</td>
<td>1,20232</td>
<td>138</td>
<td>3.86</td>
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<td>MATRIX</td>
<td>203422</td>
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<td>PDS</td>
<td>254605</td>
<td>200</td>
<td>5.3</td>
</tr>
<tr>
<td>RMC</td>
<td>264602</td>
<td>264.8</td>
<td>5.5</td>
</tr>
</tbody>
</table>

Table I: Comparison Of Various EC And ED Codes

III. CONCLUSION

The DMC protection code is utilized the decimal algorithm. The decimal algorithm consists of decimal integer addition and decimal integer subtraction to detect errors, so that more errors were detected and corrected. The Divide on symbol matrix method was used to provide enhanced memory reliability. The DMC method was corrected multiple errors in memories. When comparing to other various Error detecting and correcting codes, DMC method achieves very low area power and delay. The fault tolerant also very high.

REFERENCES