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ERROR DISCOVERY AND CORRECTION FOR SPACE ENGINEERING OF VLSI APPLICATION

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Abstract: *This paper provides an up-to-date review of error-correction codes (ECC) for computer semiconductor memory packets. Production of four error-correcting codes suitable for semiconductor memory designs is specified. In addition, the range of required check bits for commonly used information lengths is given for each code class. This paper proposes a sophisticated 2D error-correcting code that relies entirely on image segmentation to impair radiation-induced MCUs in memory for region beams. First, the diagonal, parity, and test bits were analysed using the XOR process to encode the data bits. To improve the facts, once again, an XOR operation is achieved between the encoded bits and the recomputed encoded bits. After the study, verification, selection, and correction are carried out. The proposed scheme simulated and synthesized the use of Xilinx Vivado implemented in Verilog HDL. Compared with the current widely recognized technologies, this method of encoding and interpretation consumes little power, occupies little space, and delays.*

Keywords: *Error Correction Code, Multiple Cell Upsets, Encoder, Parity, Decoder, Memory.*

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I. INTRODUCTION

In recent years, error-correcting codes (ECCs) have increasingly been used to improve device reliability and record the integrity of semiconductor memory subsystems in notebook computers. As the trend in semiconductor memory design continues towards better chip density and large storage capacity, electronic control centers (ECCs) are gaining a more valuable and powerful way to maintain a high level of system reliability [1]. The memory system can be made tolerant with the usefulness of debugging code; That is, the average time between "failures" of a well-designed memory device can be greatly extended using ECC. In this context, a device simply "fails" when errors bypass the debugging functionality of the code. Also, if you want to improve data integrity, ECC should have the function of detecting potential errors that cannot be corrected. The error-correcting codes used in early portable computer memory systems were the same quality as the SEC-DEDs invented by R.W. Hamming [2]. The SEC-DED code can correct one error and detect two keyword errors. The dual error detection function protects against data loss. In 1970, a new variety of SEC-DED codes known as Special Weight Shaft Codes were published using Hsiao. With the same coding efficiency, unnatural weight bar codes provide improvements over Hamming codes in the speed, value, and logical reliability of decoding. As a result, the strange weight column code.

In space, due to high temperatures, electronic circuits, in particular the state of memories with minor errors, cause negative reliability. In addition, memory cells are disrupted by neutrons or alpha particles from the Earth's environment. One way to reduce these errors is to maximize the critical rate at the field nodes or use well and outrigger techniques (procedure-related techniques). Another method is by applying Error Correction Codes (ECC) in the memories by which some errors can be overcome. It is usually completed with a unique Error Correction Code (SEC) in each memory to handle unbiased

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errors. Cleaning with SEC will increase accuracy. Read from your memory and correct the mistakes of the Bachelor from time to time; It will not be collected during the years. However, it is ineffective for some MCUs because extra bits are affected in this MCU or equivalent memory.

An intercalation approach is proposed to overcome a pair of cellular disturbances in memories. Several studies have been conducted using this method to treat various cellular disorders (MCUs). But this proposed interleaving method will increase the complexity of the machine design and show the impact on space and energy consumption. Therefore, the ECC has been used in the event of a pair of mobile phones (MCU) problems. However, it requires more parity bits, more time to decode the bits and more complex circuits that have to be done for the encryption and decryption processes. Many ECCs aims to reduce space, delay, and power.

The range of errors generated by a memory chip failure mainly depends on the type of chip failure. For example, cell failure can also cause errors, while line or total chip failure can currently cause multiple errors. For ECC programs, memory array chips are usually arranged so that errors caused by chip failure can be corrected with the help of ECC. In the case of SEC-DED tokens, the single-bit firm on the chip is the only design. In this organization, each part of a keyword is stored on a particular chip; For this reason, any type of segment failure can damage a small part of the keyword at most. As long as the errors do not line up on the same keyword, multiple errors can be debugged within memory [3].

II. LITERATURE SURVEY

Zhu et al. [7] propose new error-correcting codes to discount the detected radiation more than one bit changed in memory. It detects and corrects adjacent double-bit errors and also reduces errors caused by non-adjacent double-bit errors. Experimental results show that it reduces hardware redundancy by 40%

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and is more efficient than other current ECC codes. Moreover, this approach reduces errors in non-contiguous DBEs to 12%, while compared to traditional SEC-DED-DAEC codes, it results in a very reliable memory system design.

A specific set of codes (linear periodic block codes) is used because ECC protects the memory from losing records, as suggested in [4]. This system exploits MCU error localization and DS code functions to improve error correction capabilities and reduce decoding time. It is implemented in HDL, and the final result of the simulation indicates that this technique is powerful in reducing interpretation time and site and power consumption.

Reviregо et al. recommended a new coding for correcting triple-adjacent errors (SEC-DAEC-TAEC) and three-bit burst errors for different lengths of fact sentences (sixteen, 32, and sixty-four facts bits). Two criteria for improvement were used; Reducing the total number of 1s in the parity test matrix reduces the decoding time, and the largest number of 1s in its rows improves the speed.

Andrew *et al.,* [14] Suggested a fast and low-density parity machine - take a look at the space engineering code. Turbo systems and LPDC codes are widely used in data transmission for aircraft applications. Added error correction code with a lower power consumption of the region in the manner of the encoder and the translator. Low-density parity-checking codes are organized as a parity-checking matrix in which the code's price is reduced. Then the parity-checking matrix is increased, so this decoder is more complex. Faster code optimization and LPDC codes increase device performance and reliability compared to debugging codes in deep-area applications. Instead, the fastest codes are configured on networks. There may be a trellis/fact bit section for the different symbols. So faster codes are much better than low-density parity - look at low-speed codes. Compared to other decoding techniques, this iterative

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interpretation of fast code or LDPC is quite complex.

A new forward error correction code (FEC encoder) has been introduced for DVB S2 with BCH code and LPDC code and using QPSK modulation [15]. For FPGA implementation, 64800-bit code period and ½ LDPC token normal rate code are considered. The design is processed at 122MHz for the timing specification. The pipeline era is also covered in planning to improve coding efficiency. This article proposes a new set of encryption and decoding rules to correct and detect errors in many disappointing mobile devices (MCUs). The use of the XOR process was tested for encoding the register bits, diagonal, parity, and control bits. The iteration bits were again XORed, and the iteration bits were recalculated to improve the unique information. After analysis, verification, selection, and correction are put into the interpretation system.

III. ERROR CORRECTION AND DETECTION SCHEME

A new two-dimensional error-correcting code (2D-ECC) has been proposed to decorate memory reliability. This algorithm effectively detects and corrects errors while interacting with other critical error correction strategies. For example, it breaks down the proximity record, calculates frequency and syndrome, and checks and selects areas one by one to refine the real facts. The most widely used Boolean XOR operation is implemented in cryptography and in generating parity bits for error checking and fault tolerance.

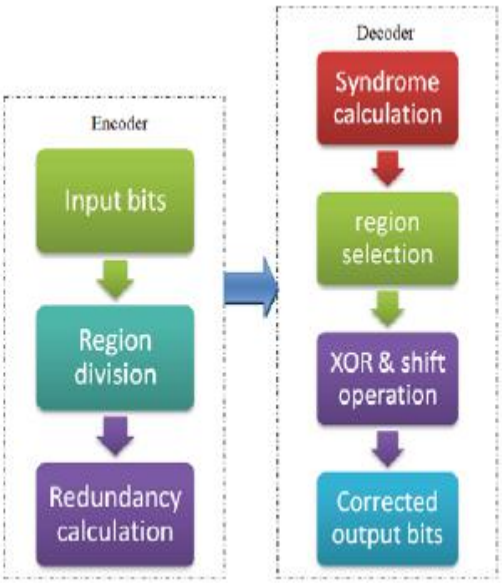

Fig.1 ECC methodology

The block diagram of the proposed ECC methodology is shown in fig. 2

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This two-dimensional algorithm reproduces the encoding interpretation procedure that encodes the sixteen-bit input information into 32-bit encoding and, while decoding it again, retrieves the sixteen-bit unique facts.

Proposed Algorithm

STEP 1: Read the input 16-bit data (A16 – A0)

STEP 2: Divide the input data into 4 groups

X_1	Y_1	Z_1	W_1
X_2	Y_2	Z_2	W_2
X_3	Y_3	Z_3	W_3
X_4	Y_4	Z_4	W_4

STEP 3: Analyse diagonal bits, parity bits and check bits using XOR operation

i) Diagonal bits (D1, D2, D3, D4) using XOR operation as the 2×2 matrix

$$D_1 = X_1 \oplus Y_2 \oplus Z_1 \oplus W_2$$
$$D_2 = X_2 \oplus Y_1 \oplus Z_2 \oplus W_1$$

ii) Parity bits (P1, P2, P3, P4) using XOR operation taking the first bits, second bits, third bits and the fourth bits from four groups

$$P_1 = X_1 \oplus Y_1 \oplus Z_1 \oplus W_1$$
$$P_2 = X_2 \oplus Y_2 \oplus Z_2 \oplus W_2$$

STEP 4: Calculate the syndrome values for diagonal, parity and check bits by performing XOR operation between the redundancy data stored and the recalculated redundancy bits (RDi, RPi, RCi)

STEP 5: Check the following conditions to identify the error that to be satisfied

STEP 6: Perform region selection and change the erroneous data to get the corrected output

Process of encoding

First, divide the 16 input bits into 4 groups (Xi, Yi, Zi, and Wi). Diagonal bits (Di), parity bits (Pi), and test bits (Ci) are determined by XORing. In coding technology, 16 input bits are converted to 32 bits (repetition bits).

ISSN: 2366-1313

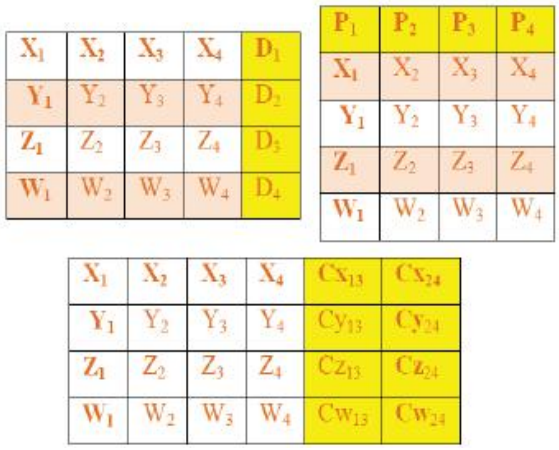

Fig.2 Encoding model

Process of decoding

In decoding, the computation of the symmetry was analyzed with the encoded information and the recomputed encoded bits (SDi, SPi, and SCi). After that, verification, site selection, and correction can be carried out.

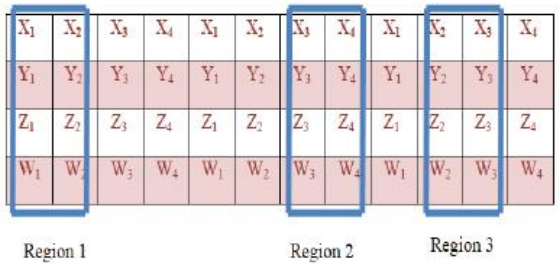

Fig.3 Different regions of data bits

IV. RESULTS AND DISCUSSION

The proposed encoding interpretation system was simulated and synthesized using Xilinx Vivado 2016. Four in Verilog HDL This proposed 2D technology can detect and correct multi-bit errors. In Figure 5 and Figure 6, the simulation results are shown.

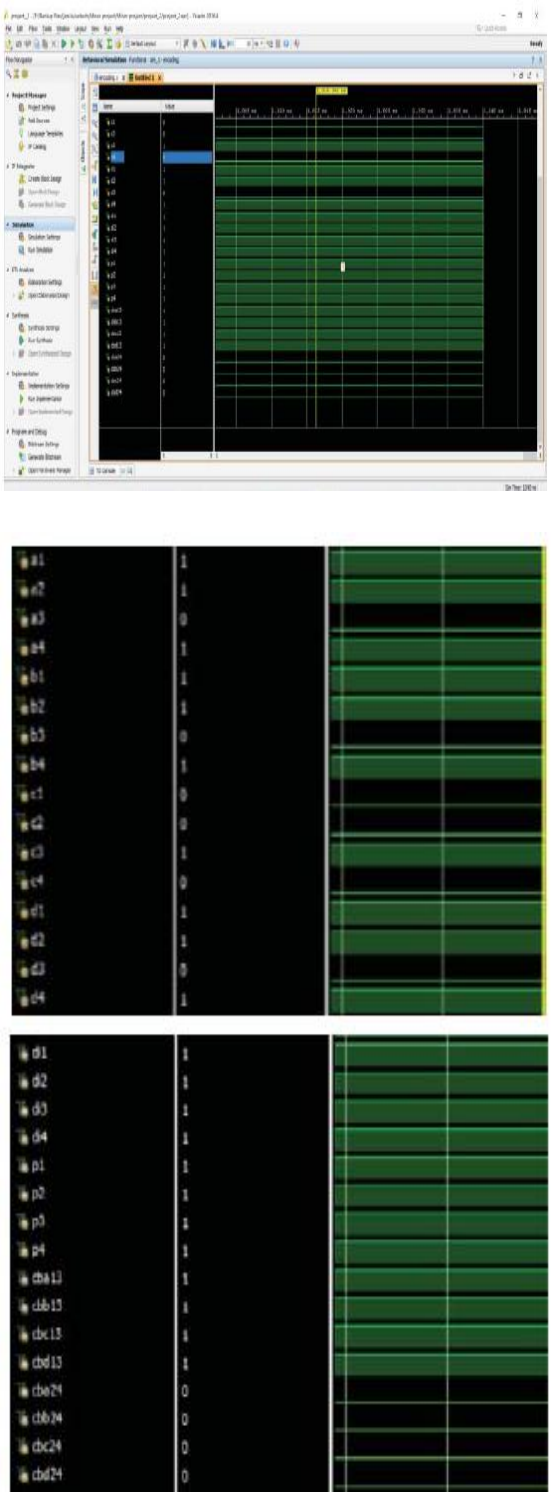

Fig. 4 Proposed encoding output

ISSN: 2366-1313

Input 16 bits and the redundancy 16 bits can be stored in the memory as 32 bits and finally decoding is performed to get the corrected output 16 bits

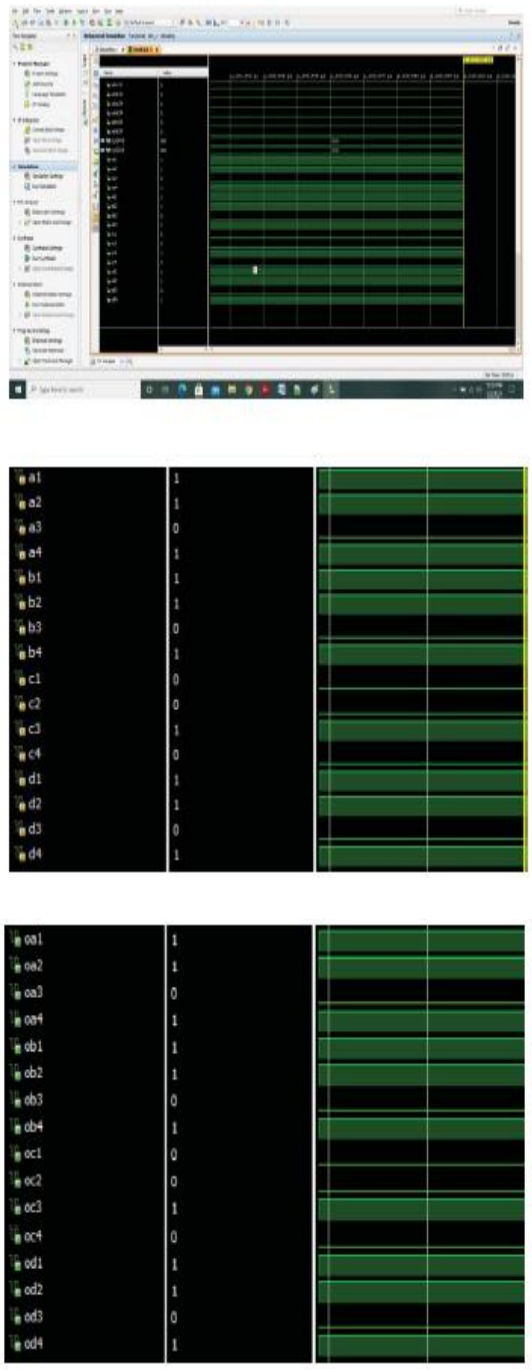

Fig. 5 Proposed decoding output

In Figure 5 and Figure 6, the effects of the encoding and decoding form indicate that the original identical information is restored at the output end after decoding. Therefore, the input registers should be retrieved from the decoded side without bit errors. This algorithm can largely complete this. Table 2 shows the required segments, LUTs, and IOBs for the encoder and decoder design. Also, the input power for the encoder and decoder circuits can be very low compared to current alternative methods. Figure 7 shows the evaluation parameters of the encoder and decoder.

CONCLUSION

This paper proposes a new error-correcting code (ECC) to reduce information corruption in dangerous memories. The proposed scheme was simulated and synthesized using a Xilinx Vivado made in Verilog HDL. The power consumed by the encoding and decoding method is zero, 167 watts, and zero 127 watts, respectively. Compared with the currently known

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strategies, this decoding system consumes little power and occupies the lowest space and delay. Also, this algorithm needs to be extended to reduce placement, delay, and power consumption. Furthermore, since regions are specifically identified, the location of the decoder will increase compared to the current alternative methods. Also, this is reduced by using the best area selection criteria.

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