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Kirschner et al.

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(54) **SYSTEMS AND METHODS FOR EFFICIENT UNCORRECTABLE ERROR DETECTION IN FLASH MEMORY**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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Related U.S. Application Data

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(51) **Int. Cl.**
G11C 29/00 (2006.01)

(52) **U.S. Cl.** **714/763**

(58) **Field of Classification Search** **714/763**
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,357,527 A 10/1994 Coates et al.
5,734,663 A 3/1998 Eggenberger
6,041,001 A 3/2000 Estakhri

6,334,201 B1 * 12/2001 Sawaguchi et al. 714/795
6,438,706 B1 8/2002 Brown
6,625,061 B2 9/2003 Higuchi
6,959,384 B1 10/2005 Serret-Avila
2004/0128511 A1 7/2004 Sun et al.
2005/0086504 A1 4/2005 You et al.
2006/0156187 A1 * 7/2006 Wu et al. 714/759
2006/0161567 A1 7/2006 Dwork et al.
2007/0150790 A1 * 6/2007 Gross et al. 714/763

FOREIGN PATENT DOCUMENTS

WO 2004/066296 8/2004

OTHER PUBLICATIONS

Renesas, Application Note, H8S/2215 Group, 0.35-um F-ZTAT Software ECC Programming., REJ06B0139-O2000/ Rev. 2.00 Mar. 2004, pp. 1-28.

* cited by examiner

Primary Examiner — Scott T Baderman

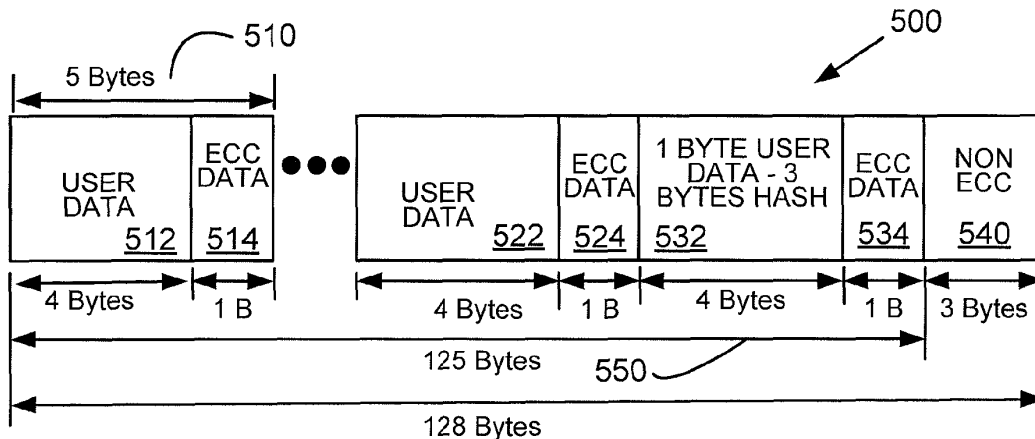
Assistant Examiner — Enam Ahmed

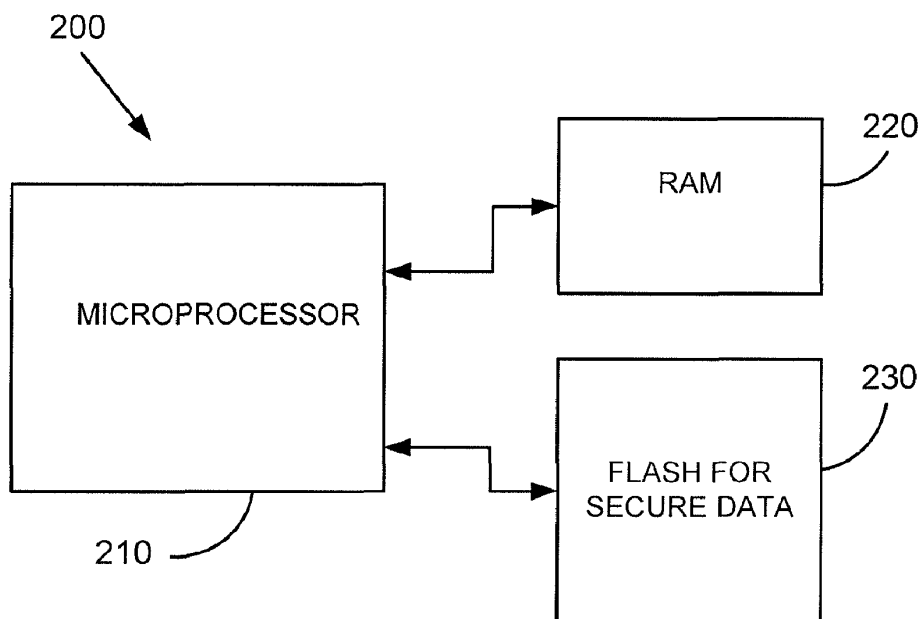
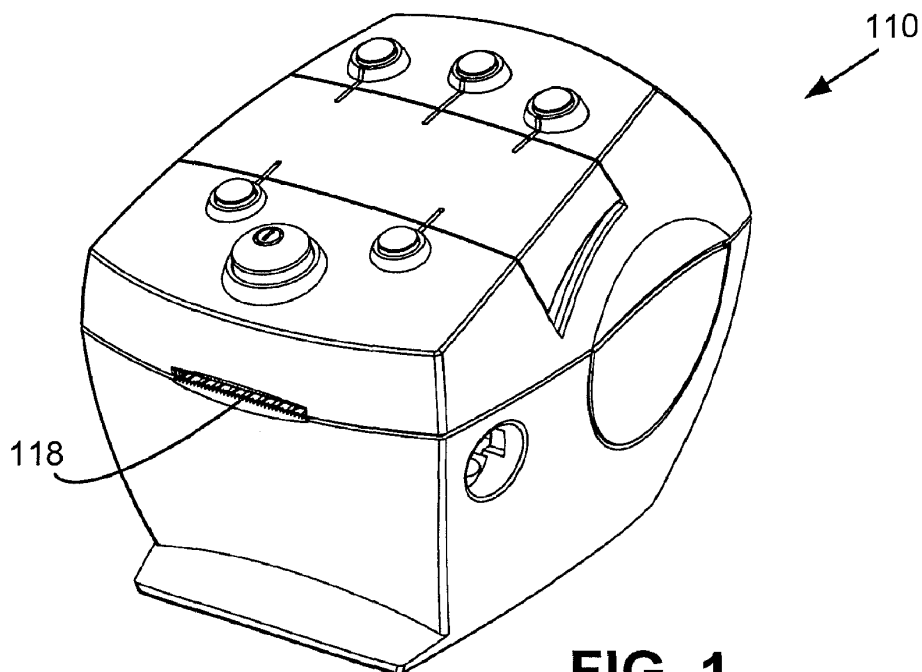
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(57) **ABSTRACT**

A system and method for efficient uncorrectable error detection in flash memory is described. A microcontroller including a non-volatile flash memory utilizes an Error Correction Code (ECC) having a certain error detection and correction bit strength. The user data is first processed by a hash function and hash data is stored with the user data. Then, the user data and hash data are processed by the ECC system. In detection, the hash ensures that a relatively low bit-strength ECC system did not incorrectly manipulate the user data. Such a hash integrity check provides an efficient, robust detection of incorrectly corrected user data resulting from errors beyond the correction but strength of the ECC system utilized.

20 Claims, 4 Drawing Sheets





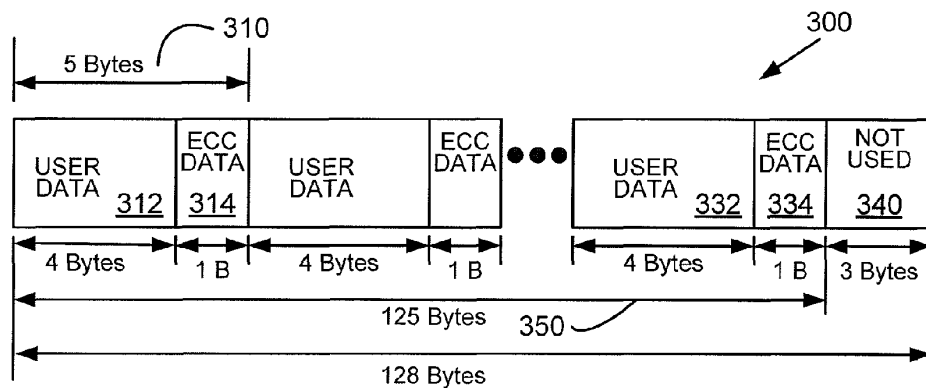


FIG. 3

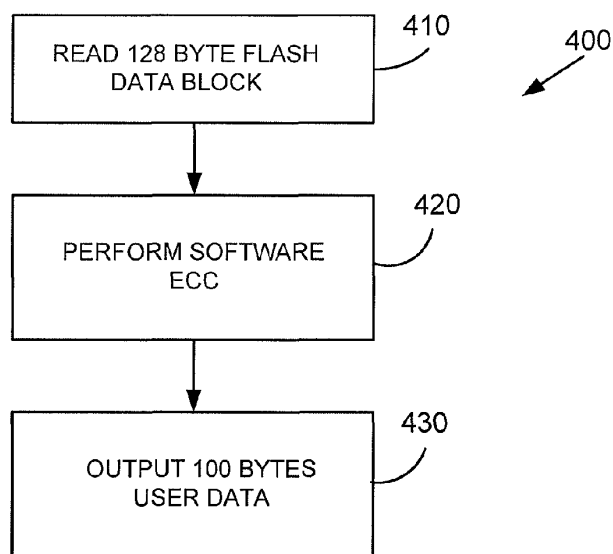


FIG. 4

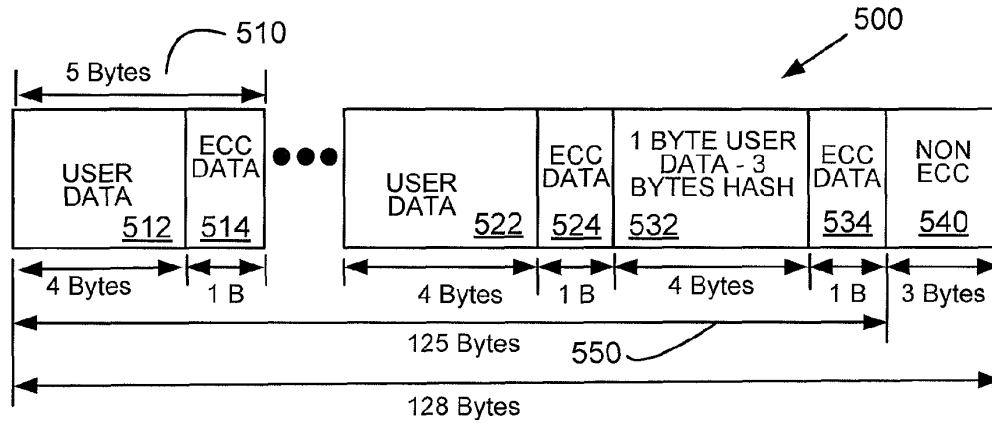


FIG. 5

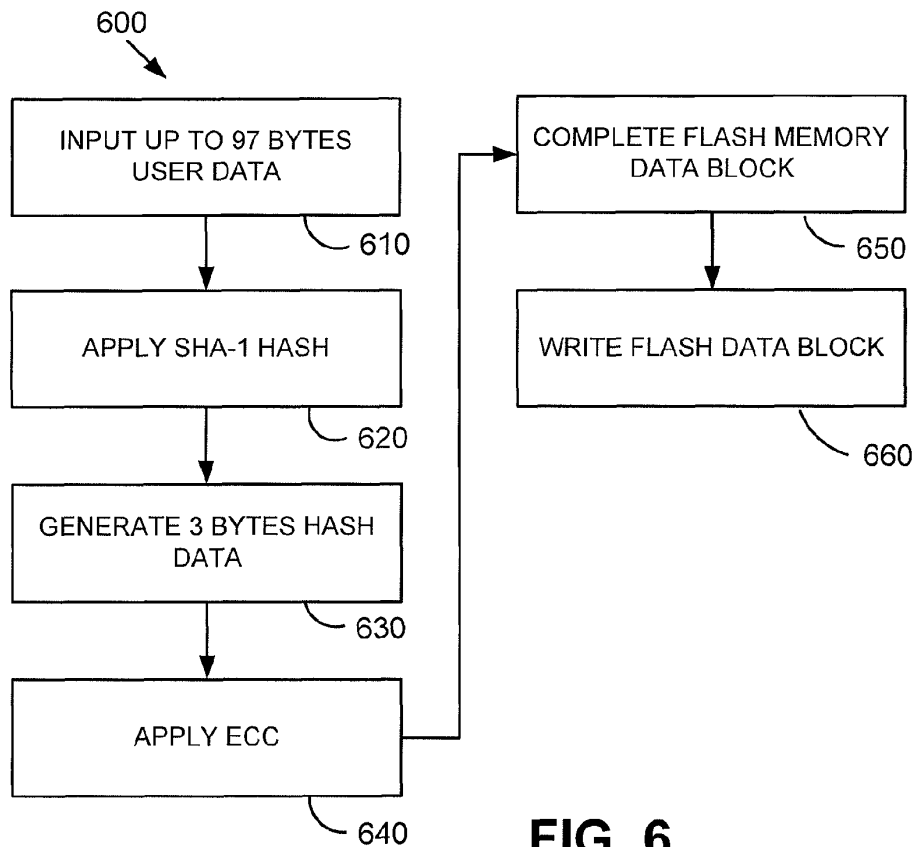


FIG. 6

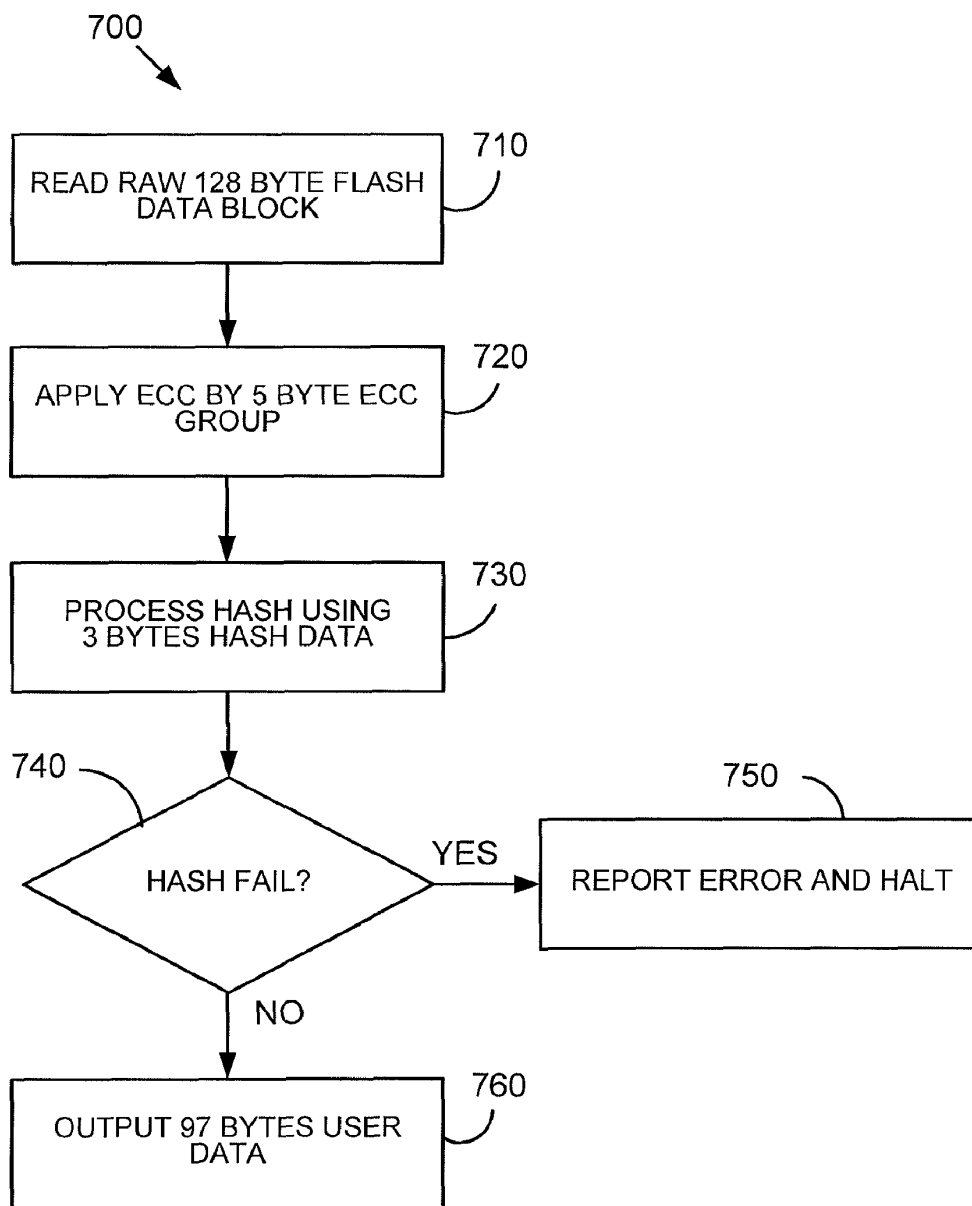


FIG. 7

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