Survey of Non-Volatile Memories: a taxonomy

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***Abstract*— This electronic document is a ÒliveÓ template. The various components of your paper [title, text, heads, etc.] are already defined on the style sheet, as illustrated by the portions given in this document.**

I. INTRODUCTION

O consumo de energia é tão importante quanto o desempenho em sistemas embarcados alimentados por bateria, pois cada vez mais estes sistemas precisam processar computação intensiva com um baixo consumo energético. Devido à alta contribuição do acesso à memória no consumo total de energia de sistemas embarcados, a arquitetura de memória influencia fortemente os objetivos dos projetos dos dispositivos embarcados. Novas técnicas são propostas devido aos problemas enfrentados com o avanço da tecnologia, como por exemplo, a memória tradicional baseada em SRAM (*Static Random Access Memory*) *on-chip* tornou-se um gargalo em consumo energético para o projeto de sistemas embarcados, devido principalmente ao seu alto *leakage*. As tecnologias emergentes de memórias não voláteis (*NVM, Non-Volatile Memories*), tal como STT-RAM (*Spin-Transfer Torque RAM*) e PCRAM (*Phase Change RAM*), são soluções candidatas para os futuros sistemas de memória, pois elas possuem algumas vantagens sobre as memórias SRAMs e DRAMs tradicionais, como por exemplo, um menor *leakage*, uma maior densidade e não volatilidade. Além das tecnologias emergentes de memória citadas, outras são apresentadas na literatura, tais como FeRAM, FETRAM, ReRAM, MRAM, PCM, entre outras. Estas tecnologias emergentes apresentam algumas desvantagens, tais como tempo de vida limitado pelo número de reescritas e também o desempenho assimétrico entre as operações de leitura e escrita.

II. OVERVIEW - NVM'S

Os requisitos necessários para os sistemas embarcados têm motivado a investigação de técnicas de otimização que diminuem o consumo energético sem que ocorra uma degradação do desempenho original, ou que aumente o desempenho sem que ocorra um grande aumento do consumo energético do sistema. A hierarquia de memória influencia fortemente o desempenho e consumo energético, pois, de acordo com a hierarquia empregada, o tempo e o consumo energético do acesso ao endereço possuirá resultados diferentes dependendo do nível da hierarquia, do tipo e do tamanho da memória empregada que o endereço está contido.

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TABLE I
CLASSIFICAÇÃO DE MEMÓRIAS NÃO-VOLÁTEIS

Classificação	Referências
Tecnologia de memória	Listar papers
Memórias híbridas	Listar
Cache	Listar
SPM	Listar
Memória principal	Listar
Economia de energia	Listar
Melhoria de desempenho	Listar

Na literatura são propostos diversos tipos de otimizações em memória, desde técnicas de otimização em *software*, em *hardware* ou técnicas mistas as quais utilizam tanto otimizações de *hardware* quanto de *software* [**?**].

Muitas dessas técnicas utilizam NVMs como uma forma de otimização, visto que essas memórias emergentes possuem algumas vantagens em relação as memórias tradicionais DRAM (*Dynamic Random-Access Memory*) e SRAM (*Static Random-Access Memory*). Visando explorar diferentes tecnologias, nos últimos anos diversos trabalhos estão utilizando NVMs com o intuito de melhorar os resultados das tradicionais DRAM e SRAM, como observado nos trabalhos de [**?**], [**?**], [**?**] e [**?**].

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A. Abbreviations and Acronyms

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

B. Units

- Use either SI (MKS) or CGS as primary units. (SI units are encouraged.) English units may be used as secondary units (in parentheses). An exception would be the use of English units as identifiers in trade, such as Ò3.5-inch disk driveÓ.
- Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity that you use in an equation.
- Do not mix complete spellings and abbreviations of units: ÒWb/m2Ó or Òwebers per square meterÓ, not Òwebers/m2Ó. Spell out units when they appear in text: Ò. . . a few henriesÓ, not Ò. . . a few HÓ.
- Use a zero before decimal points: Ò0.25Ó, not Ò.25Ó. Use Òcm3Ó, not ÒccÓ. (bullet list)

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$$\alpha + \beta = \chi \tag{1}$$

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D. Some Common Mistakes

- The word ÒdataÓ is plural, not singular.
- The subscript for the permeability of vacuum ?0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter ÒoÓ.
- In American English, commas, semi-/colons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)
- A graph within a graph is an ÒinsetÓ, not an ÒinsertÓ. The word alternatively is preferred to the word ÒalternatelyÓ (unless you really mean something that alternates).
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- There is no period after the ÒetÓ in the Latin abbreviation Òet al.Ó.
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IV. CONCLUSION AND FUTURE TRENDS

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Text heads organize the topics on a relational, hierarchical basis. For example, the paper title is the primary text head

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TABLE II
AN EXAMPLE OF A TABLE

One	Two
Three	Four

We suggest that you use a text box to insert a graphic (which is ideally a 300 dpi TIFF or EPS file, with all fonts embedded) because, in an document, this method is somewhat more stable than directly inserting a picture.

Fig. 1. Inductance of oscillation winding on amorphous magnetic core versus DC bias magnetic field

Figure Labels: Use 8 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader. As an example, write the quantity ÒMagnetizationÓ, or ÒMagnetization, MÓ, not just ÒMÓ. If including units in the label, present them within parentheses. Do not label axes only with units. In the example, write ÒMagnetization (A/m)Ó or ÒMagnetization A[m(1)]Ó, not just ÒA/mÓ. Do not label axes with a ratio of quantities and units. For example, write ÒTemperature (K)Ó, not ÒTemperature/K.Ó

V. CONCLUSIONS

A conclusion section is not required. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

APPENDIX

Appendixes should appear before the acknowledgment.

ACKNOWLEDGMENT

The preferred spelling of the word ÒacknowledgmentÓ in America is without an ÒeÓ after the ÒgÓ. Avoid the stilted expression, ÒOne of us (R. B. G.) thanks . . .Ó Instead, try ÒR. B. G. thanksÓ. Put sponsor acknowledgments in the unnumbered footnote on the first page.

References are important to the reader; therefore, each citation must be complete and correct. If at all possible, references should be commonly available publications.

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