(54) Title: ARCHITECTURE FOR MICROPROCESSOR-BASED SYSTEMS INCLUDING SIMD PROCESSING UNIT AND ASSOCIATED SYSTEMS AND METHODS
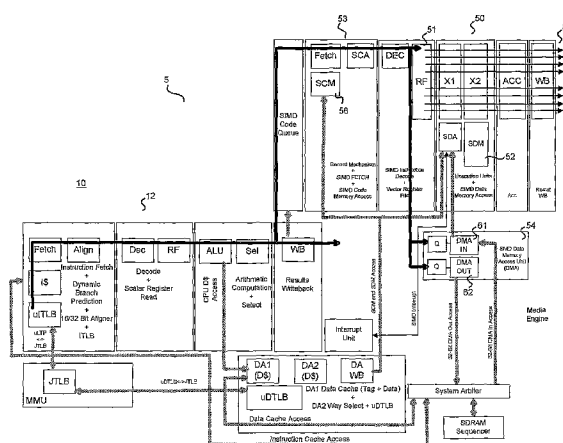
(57) Abstract: An architecture for microprocessor-based systems is provided. The architecture includes a SIMD processing unit and associated systems and methods for optimizing the performance of such a system. In one embodiment systems and methods for performing systolic array-based block matching are provided. In another embodiment, a parameterizable clip instruction is provided. In an additional embodiment, two pair of deblocking instruction for use with the H.264 and VCl codecs provided. In a further embodiment, an instruction and datapath for accelerating sub-pixel interpolation are provided. In another embodiment, systems and methods for selectively decoupling processor extension logic are provided. In yet another embodiment, systems and methods for recording instruction sequences in a microprocessor having dynamically decoupleable extension logic is provided, hi yet one other embodiment, systems and methods for synchronizing multiple processing engines of a SIMD engine are provided.

*For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.*

# INTERNATIONAL SEARCH REPORT

## A. CLASSIFICATION OF SUBJECT MATTER
INV. G06F9/38

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, INSPEC

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | WO 93/08526 A (INTEL CORP [US]) 29 April 1993 (1993-04-29) page 5, line 1 - line 10 figures 4a,5a page 9, line 1 - line 20 ----- | 1 |
| A | US 5 884 057 A (BLOMGREN JAMES S [US] ET AL) 16 March 1999 (1999-03-16) column 2, line 27 - line 58 column 4, line 24 - line 33 ----- | 1 |
| A | GB 2 365 583 B (HEWLETT PACKARD CO [US]) 4 August 2004 (2004-08-04) page 1, line 28 - page 2, line 14 ----- | 1 |

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[X] Further documents are listed in the continuation of Box C.          [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 30 July 2007 | 24/10/2007 |

| Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016 | Authorized officer Brandt, Jan |
|---|---|

Form PCT/ISA/210 (second sheet) (April 2005)

# INTERNATIONAL SEARCH REPORT

| C(Continuation). | DOCUMENTS CONSIDERED TO BE RELEVANT | |
|---|---|---|
| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| A | SMITH J E ET AL: "THE ASTRONAUTICS ZS-1 PROCESSOR" PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON COMPUTER DESIGN : VLSI IN COMPUTERS AND PROCESSORS. (ICCD). NEW YORK, OCT. 3 - 5, 1988, WASHINGTON, IEEE COMP. SOC. PRESS, US, 3 October 1988 (1988-10-03), pages 307-310, XP000093793 ISBN: 0-8186-0872-2 the whole document ----- | 1 |

# INTERNATIONAL SEARCH REPORT

**Box II   Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box III   Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

    see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

    1

**Remark on Protest**          ☐ The additional search fees were accompanied by the applicant's protest.

                               ☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (January 2004)

**FURTHER INFORMATION CONTINUED FROM    PCT/ISA/ 210**

This International Searching Authority found multiple (groups of)
inventions in this international application, as follows:

1. claim: 1

   An instruction queue coupling two instruction pipelines
   between their respective front
   end and rear portions.

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2. claim: 2

   Issuing a begin record instruction to an extended
   instruction pipeline, causing the extended instruction
   pipeline to begin recording a sequence of instructions
   issued by a main instruction pipeline.

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3. claim: 3

   Coupling direct memory access (DMA) engines to an extended
   instruction pipeline; and
   blocking the extended instruction pipeline from further
   execution when a DMA engine
   instruction queue is full and a new DMA instruction arrives
   at the queue, until a current
   DMA operation is complete.

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4. claim: 4

   A method of performing block matching with a systolic array.

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5. claim: 5

   A method of causing a microprocessor to perform a clip
   operation.

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6. claim: 6

   A method of causing a microprocessor to perform a CODEC
   deblocking operation.

   ---

7. claim: 7

   Performing heterogeneous arithmetic interpolation operations
   in a SIMD processor.

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| Patent document cited in search report | | Publication date | Patent family member(s) | | Publication date |
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| | | | US | 6629167 B1 | 30-09-2003 |