(54) Title: LATTICE TOUCH-SENSING SYSTEM

(57) Abstract: This invention is directed to a lattice touch-sensing system for detecting a position of a touch on a touch-sensitive surface. The lattice touch-sensing system may include two capacitive sensing layers, separated by an insulating material, where each layer consists of substantially parallel conducting elements, and the conducting elements of the two sensing layers are substantially orthogonal to each other. Each element may comprise a series of diamond shaped patches that are connected together with narrow conductive rectangular strips. Each conducting element of a given sensing layer is electrically connected at one or both ends to a lead line of a corresponding set of lead lines. A control circuit may also be included to provide an excitation signal to both sets of conducting elements through the corresponding sets of lead lines, to receive sensing signals generated by sensor elements when a touch on the surface occurs, and to determine a position of the touch based on the position of the affected bars in each layer.

Declarations under Rule 4.17:
— as to applicant’s entitlement to apply for and be granted a patent (Rule 4.17(ii)) for all designations

Published:
— with international search report

(88) Date of publication of the international search report:
22 September 2005

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G06F3/033 H03K17/96

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)

IPC 7 G06F H03K

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>Y</td>
<td>abstract column 1, lines 17-65 - column 2, lines 23-33; figures 1-6,10 column 3, lines 5-61 - column 4, lines 22-27 column 4, line 56 - column 5, line 31 column 5, line 66 - column 6, line 1 column 6, line 34 - column 7, line 6 column 8, lines 7-25</td>
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Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

"A" 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

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

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"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.

"a" document member of the same patent family

Date of the actual completion of the international search: 12 April 2005

Date of mailing of the international search report: 04.07.05

Name and mailing address of the ISA

European Patent Office, P.B. 5816 Patentlaan 2 NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016

Authorized officer: Quesson, C

Form PCT/ISA/210 (second sheet) (January 2004)
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<td>EP 0 250 931 A (INTERNATIONAL BUSINESS MACHINES CORPORATION) 7 January 1988 (1988-01-07)</td>
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INTERNATIONAL SEARCH REPORT

Box I  Observations where certain claims were found unsearchable (Continuation of item 1 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 II  Observations where unity of invention is lacking (Continuation of item 2 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.:

   1-9, 16-26

Remark on Protest

☐ The additional search fees were accompanied by the applicant’s protest.

☐ No protest accompanied the payment of additional search fees.
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-9,16-26

   A touch-sensitive screen and a method for identifying a location of a touch on same, the touch-sensitive screen comprising:
   a touching surface; and
   a first layer and a second layer including respectively a first set and a second set of sensor bars disposed in a first and in a second, different direction, the sensor bars of the two layers being connected to lead lines at a first end of the sensor bars

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2. claims: 10-15

   A touch-sensitive screen comprising:
   a touching surface; and
   a first sensor layer having rows of patches of conductive material and depletion areas between the patches of conductive material;
   a second sensor layer having rows of patches of conductive material, the rows of the first and second layers being configured such that the patches of the second layer are disposed within the depletion areas of the second layer

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3. claims: claims 27-31

   A method for determining a location of a touch to a touch-sensitive screen, comprising:
   determining if a least one signal is present from each of at least two layers of sensor bars; if so:
   evaluating a first signal corresponding to a first sensor bar in a first layer of sensor bars to determine a first position in a first direction associated with the first layer of sensor bars, and
   evaluating a second signal corresponding to a second sensor bar in a second layer of sensor bars to determine a position in a second direction associated with the second layer of sensor bars; and
   reporting the location of the touch as the first position in the first direction and the second position in the second direction.
<table>
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<tr>
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<tr>
<td>US 6137427</td>
<td>24-10-2000</td>
<td>DE 69528698 D1</td>
<td>05-12-2002</td>
</tr>
<tr>
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<td>DE 69528698 T2</td>
<td>10-07-2003</td>
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<tr>
<td></td>
<td></td>
<td>EP 1298803 A2</td>
<td>02-04-2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ES 2187556 T3</td>
<td>16-06-2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 9527334 A1</td>
<td>12-10-1995</td>
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<tr>
<td></td>
<td></td>
<td>JP 9511086 T</td>
<td>04-11-1997</td>
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<tr>
<td></td>
<td></td>
<td>US 5844506 A</td>
<td>01-12-1998</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 4686332 A</td>
<td>11-08-1987</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 0250931 A2</td>
<td>07-01-1988</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HK 139694 A</td>
<td>16-12-1994</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 1754522 C</td>
<td>23-04-1993</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 4048244 B</td>
<td>06-08-1992</td>
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<tr>
<td></td>
<td></td>
<td>JP 63008818 A</td>
<td>14-01-1988</td>
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<td>US 4973605 A</td>
<td>27-11-1990</td>
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