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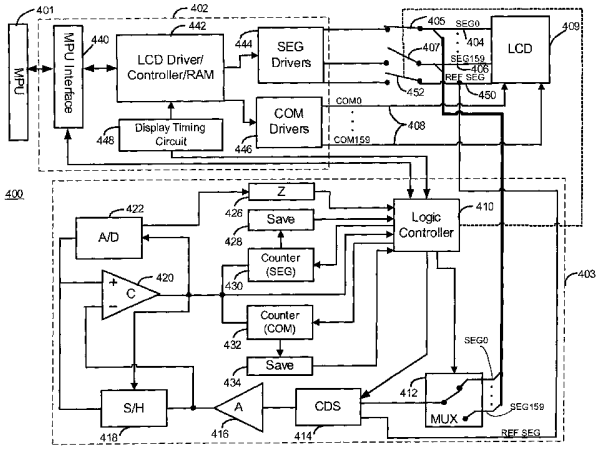
(54) Title: DEVICE AND METHOD OF INTEGRATING A TOUCHSCREEN WITHIN AN LIQUID CRYSTAL DISPLAY



(57) Abstract: A touchscreen liquid crystal display that includes a liquid crystal display (100, 300, 409) including a viewing surface, a liquid crystal area containing liquid crystal (112) located behind the viewing surface, a plurality of spaced apart elongate first electrodes (108) located on a viewing surface side of the liquid crystal area and a plurality of spaced apart elongate second electrodes (116) located on an opposite side of the liquid crystal area, the first and second electrodes (108, 116) overlapping to form an array of liquid crystal pixel elements, at least some of the first electrodes (108) being displaceable towards the second electrodes (116) in response to external pressure applied to the viewing surface. A control circuit (400) is connected to the first and second electrodes (108, 116) for controlling the operation of the liquid crystal display (100, 300, 409). The control circuit (400) includes (i) a driver circuit (402) for driving the electrodes (108, 116) for selectively controlling a display state of the pixel elements; and (ii) a measurement circuit (403) for detecting displacement of the at least some of the first electrodes (108) in response to external pressure applied to the viewing surface.

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INTERNATIONAL SEARCH REPORT

tional Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06F3/033 G02F1/133

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 G02F G06K

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, COMPENDEX, INSPEC, PAJ, IBM-TDB, WPI Data, BIOSIS, EMBASE, FSTA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 159 323 A (MASE AKIRA ET AL) 27 October 1992 (1992-10-27) the whole document	1-6,8-13
X	US 4 814 760 A (JOHNSTON JAMES P ET AL) 21 March 1989 (1989-03-21) the whole document	1-6,8-13
X	US 4 529 968 A (HILSUM CYRIL ET AL) 16 July 1985 (1985-07-16) claims 1-3,5,6,11,12; figures 2,4-8	1-6,8,9, 11-13
X	US 4 224 615 A (PENZ PERRY A) 23 September 1980 (1980-09-23) figures 3-6	1-6,8-13

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in 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

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"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

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"&" 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 March 2004	28. 06. 2004

Name and mailing address of the ISA	Authorized officer
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	Wolfrum, G

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INTERNATIONAL SEARCH REPORT

tional Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 012, no. 086 (P-677), 18 March 1988 (1988-03-18) -& JP 62 218941 A (MITSUBISHI ELECTRIC CORP), 26 September 1987 (1987-09-26) abstract; figures 1-6	1-6,8-13
X	PATENT ABSTRACTS OF JAPAN vol. 014, no. 449 (P-1111), 26 September 1990 (1990-09-26) -& JP 02 178618 A (SEIKOSHA CO LTD), 11 July 1990 (1990-07-11) abstract; figures 1,2	1-6,8-13
A	US 4 363 029 A (PILIAVIN MICHAEL A ET AL) 7 December 1982 (1982-12-07) column 3, line 34 - line 53; figures 1-5	5,6
A	US 6 239 788 B1 (IWAHASHI HIROYUKI ET AL) 29 May 2001 (2001-05-29) the whole document	1-6,8-13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA 03/01822

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.:

see annex

Remark on Protest

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

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-6,8-13

A touchscreen liquid crystal display and the corresponding method steps for driving it, said touchscreen liquid crystal display comprising first and second electrodes overlapping to form an array of liquid crystal pixel elements, at least some of the first electrodes being displaceable towards the second electrodes; and a control circuit including (i) a driver circuit for driving the electrodes for controlling a display state of the pixel elements; and (ii) a measurement circuit for detecting displacement of the at least some of the first electrodes in response to external pressure wherein a reference pixel element is located outside a viewable area of said liquid crystal display and the measurement circuit includes a comparison circuit for comparing the measured voltages at the electrodes to a reference voltage from said reference pixel element.

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2. claims: 1,7,12-18

A touchscreen liquid crystal display and the corresponding method steps for driving it, said touchscreen liquid crystal display comprising first and second electrodes overlapping to form an array of liquid crystal pixel elements, at least some of the first electrodes being displaceable towards the second electrodes; and a control circuit including (i) a driver circuit for driving the electrodes for controlling a display state of the pixel elements; and (ii) a measurement circuit for detecting displacement of the at least some of the first electrodes in response to external pressure wherein in a first mode the measurement circuit measures the electrical characteristic of a subset of pixel elements until said electrical characteristic indicates that external pressure has been applied and in a second mode after the first mode, the measurement circuit measures the electrical characteristic of a larger set of pixel elements and determines the location of said external pressure.

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3. claims: 12,13,19,20

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

A method of driving a touchscreen liquid crystal display, said touchscreen liquid crystal display comprising first and second electrodes overlapping to form an array of liquid crystal pixel elements, at least some of the first electrodes being displaceable towards the second electrodes; the method including the steps of (a) driving the electrodes to cause the pixel elements to display an image; and (b) sampling voltages between said electrodes; and (c) determining based on the sampled voltages if any of the at least some of the first electrodes have been displaced towards the second electrodes
wherein the center of deflection of the first electrodes is determined by determining a weighted average of the deflection at a plurality of pixel location and determining a centroid of the deflection based on the weighted average.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/CA 03/01822

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