

(51) International Patent Classification:  
*G02B 5/20* (2006.01)(21) International Application Number:  
PCT/US2012/032543(22) International Filing Date:  
6 April 2012 (06.04.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
61/472,690 7 April 2011 (07.04.2011) US(71) Applicant (for all designated States except US): **E INK CORPORATION** [US/US]; 733 Concord Avenue, Cambridge, Massachusetts 02138-1002 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **PAOLINI, JR., Richard J.** [US/US]; 10 Hickory Hill Lane, Framingham, Massachusetts 01702 (US). **TELFER, Stephen J.** [US/US]; 40 College Avenue, Arlington, Massachusetts 02474-2254 (US). **BOUCHARD, Alain** [US/US]; Unit 8, 944 Dorchester Avenue, Dorchester, Massachusetts 02125(US). **ATKINSON, John** [US/US]; Apartment No. 1, 7 Farragut Avenue, Somerville, Massachusetts 02144 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: TETRACHROMATIC COLOR FILTER ARRAY

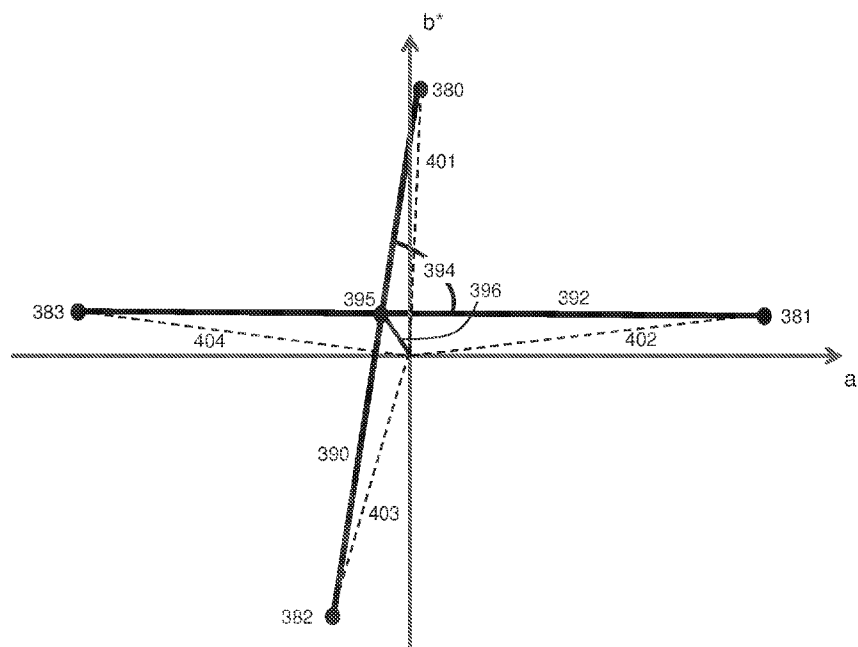


FIG. 3B

(57) Abstract: A tetrachromatic color filter array comprises multiple pixels, each of which comprises first, second, third and fourth sub-pixels having first, second, third and fourth hues, P1, P2, P3 and P4 respectively, these first, second, third and fourth hues having first, second and third hue angles,  $h1$ ,  $h2$ ,  $h3$  and  $h4$  respectively. The hues of the sub-pixels such that  $h3$  equals  $h1 + (180^\circ \pm 10^\circ)$  and  $h4$  equals  $h2 + (180^\circ \pm 10^\circ)$  in the  $a^*b^*$  plane of the  $La^*b^*$  color space.

**Declarations under Rule 4.17:**

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

**Published:**

— *with international search report (Art. 21(3))*

**(88) Date of publication of the international search report:**

28 February 2013

**A. CLASSIFICATION OF SUBJECT MATTER****G02B 5/20(2006.01)i**

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)

G02B 5/20; G02F 1/167; G02B 5/22; H04N 9/077; H04N 9/07; G02F 1/1335; G09G 5/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) &amp; Keywords: color filter array, fourth sub-pixel, hue angle, tetrachromatic

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                            | Relevant to claim No. |
|-----------|---------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | US 04670777 A (ISHIKAWA; KIYOTSUGU et al.) 02 June 1987<br>See abstract, claim 1, lines 15-53 and figure 7.   | 1-17                  |
| A         | US 05642176 A (ABUKAWA; KOTARO et al.) 24 June 1997<br>See abstract, column 3, lines 15-40 and figure 2.      | 1-17                  |
| A         | US 2009-0237776 A1 (BOUCHARD ALAIN) 24 September 2009<br>See abstract and claim 1.                            | 1-17                  |
| A         | US 2007-0057963 A1 (CANDICE HELLEN BROWN ELLIOTT et al.) 15 March 2007<br>See paragraph [0005] and figure 27. | 1-17                  |



Further documents are listed in the continuation of Box C.



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 application or patent 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 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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

24 DECEMBER 2012 (24.12.2012)

Date of mailing of the international search report

**26 DECEMBER 2012 (26.12.2012)**

Name and mailing address of the ISA/KR

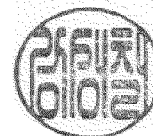
Korean Intellectual Property Office  
189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan  
City, 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

KANG Sung Chul

Telephone No. 82-42-481-5666



**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2012/032543**

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Publication<br>date                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| US 04670777 A                             | 02.06.1987          | JP 06-028450 B2<br>JP 2039327 C<br>JP 59-137909 A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 13.04.1994<br>28.03.1996<br>08.08.1984                                                                                                                                                                                                                                                                                                                                                                                                                       |
| US 05642176 A                             | 24.06.1997          | EP 0715202 A2<br>EP 0715202 A3<br>EP 0715202 B1<br>JP 03-040943 B2<br>JP 08-211223 A<br>JP 3040943 B2<br>KR 10-0186818 B1                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 05.06.1996<br>13.11.1996<br>20.02.2002<br>03.03.2000<br>20.08.1996<br>15.05.2000<br>01.05.1999                                                                                                                                                                                                                                                                                                                                                               |
| US 2009-0237776 A1                        | 24.09.2009          | JP 2011-517490 A<br>KR 10-2010-0116224 A<br>US 8054526 B2<br>WO 2009-117730 A1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 09.06.2011<br>29.10.2010<br>08.11.2011<br>24.09.2009                                                                                                                                                                                                                                                                                                                                                                                                         |
| US 2007-0057963 A1                        | 15.03.2007          | AU 2002-353143 A1<br>AU 2002-357189 A1<br>AU 2003-270455 A1<br>AU 2003-270455 A8<br>CN 100510883 C<br>CN 100541587 C<br>CN 101325025 A<br>CN 101325025 B<br>CN 101325026 A<br>CN 101325026 B<br>CN 101325027 A<br>CN 101325028 A<br>CN 101325028 B<br>CN 1639765 A<br>CN 1639765 C0<br>CN 1722193 A<br>CN 1722193 C0<br>CN 1774664 A<br>CN 1774664 C0<br>CN 1998041 A0<br>CN 2906675 Y0<br>EP 1461800 A1<br>EP 1461801 A1<br>EP 1579409 A2<br>EP 1579409 A3<br>EP 1741283 A2<br>EP 1741283 A4<br>EP 2270579 A2<br>EP 2270579 A3<br>JP 04-299672 B2<br>JP 04-647213 B2<br>JP 04-918028 B2 | 30.07.2003<br>30.07.2003<br>30.04.2004<br>30.04.2004<br>08.07.2009<br>16.09.2009<br>17.12.2008<br>08.12.2010<br>17.12.2008<br>30.11.2011<br>17.12.2008<br>17.12.2008<br>31.08.2011<br>13.07.2005<br>03.12.2008<br>18.01.2006<br>18.01.2006<br>17.05.2006<br>17.05.2006<br>11.07.2007<br>30.05.2007<br>29.09.2004<br>29.09.2004<br>28.09.2005<br>28.12.2005<br>10.01.2007<br>12.09.2007<br>05.01.2011<br>17.08.2011<br>24.04.2009<br>17.12.2010<br>03.02.2012 |

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2012/032543**

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
|                                           |                     | JP 2005-515504 A           | 26.05.2005          |
|                                           |                     | JP 2005-515505 A           | 26.05.2005          |
|                                           |                     | JP 2007-532949 A           | 15.11.2007          |
|                                           |                     | KR 10-0906632 B1           | 10.07.2009          |
|                                           |                     | KR 10-0926305 B1           | 12.11.2009          |
|                                           |                     | KR 10-1010004 B1           | 21.01.2011          |
|                                           |                     | KR 10-1066413 B1           | 21.09.2011          |
|                                           |                     | KR 10-1066416 B1           | 21.09.2011          |
|                                           |                     | KR 10-1066420 B1           | 21.09.2011          |
|                                           |                     | KR 10-1093230 B1           | 13.12.2011          |
|                                           |                     | KR 20050052496 A           | 02.06.2005          |
|                                           |                     | KR 20100113150 A           | 20.10.2010          |
|                                           |                     | KR 20100113151 A           | 20.10.2010          |
|                                           |                     | KR 20100113152 A           | 20.10.2010          |
|                                           |                     | TW 1276886B                | 21.03.2007          |
|                                           |                     | TW 276886 A                | 21.03.2007          |
|                                           |                     | TW 276886 B                | 21.03.2007          |
|                                           |                     | US 2003-0128179 A1         | 10.07.2003          |
|                                           |                     | US 2003-0128225 A1         | 10.07.2003          |
|                                           |                     | US 2004-0051724 A1         | 18.03.2004          |
|                                           |                     | US 2004-0080479 A1         | 29.04.2004          |
|                                           |                     | US 2005-0225574 A1         | 13.10.2005          |
|                                           |                     | US 2005-0225575 A1         | 13.10.2005          |
|                                           |                     | US 2007-0052887 A1         | 08.03.2007          |
|                                           |                     | US 2007-0064020 A1         | 22.03.2007          |
|                                           |                     | US 2010-0164978 A1         | 01.07.2010          |
|                                           |                     | US 7417648 B2              | 26.08.2008          |
|                                           |                     | US 7492379 B2              | 17.02.2009          |
|                                           |                     | US 7505053 B2              | 17.03.2009          |
|                                           |                     | US 7573493 B2              | 11.08.2009          |
|                                           |                     | US 7583279 B2              | 01.09.2009          |
|                                           |                     | US 7701476 B2              | 20.04.2010          |
|                                           |                     | US 7755652 B2              | 13.07.2010          |
|                                           |                     | US 8294741 B2              | 23.10.2012          |
|                                           |                     | WO 03-060869 A1            | 24.07.2003          |
|                                           |                     | WO 03-060870 A1            | 24.07.2003          |
|                                           |                     | WO 2004-025611 A2          | 25.03.2004          |
|                                           |                     | WO 2004-025611 A3          | 10.11.2005          |
|                                           |                     | WO 2004-025611 A3          | 25.03.2004          |
|                                           |                     | WO 2005-101807 A2          | 27.10.2005          |
|                                           |                     | WO 2005-101807 A3          | 27.10.2005          |