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- (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.
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(54) **Title:** METHODS AND APPARATUS FOR DITHER SELECTION

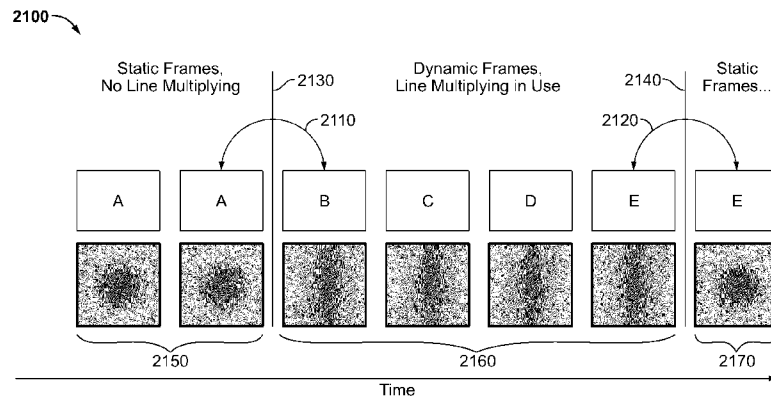
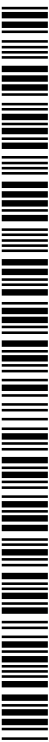


Figure 21

(57) **Abstract:** Systems, methods and apparatus including computer programs encoded on computer storage media optimize display image quality under a variety of imaging environments. Dynamic frame streams such as those present in video applications may require a higher frame rate to adequately convey motion in the stream. A line multiplying image pipeline may be utilized for dynamic frames, which lowers the resolution of the displayed image. When dithering line multiplied images, a noise signal including asymmetrical high frequency components around zero frequency may be utilized. The display of static frames, such as photographs, may be achieved with acceptable image quality using a relatively lower display frame rate. Such a frame rate may enable the display of a high resolution image. A noise signal tailored for higher resolution, non line multiplied frames, such as a noise signal with symmetrical high frequency components around zero frequency may be utilized for static frames.



# INTERNATIONAL SEARCH REPORT

International application No <b>PCT/US2012/027879</b>
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<b>A. CLASSIFICATION OF SUBJECT MATTER</b> INV. G09G3/34                      G09G3/20 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols) G09G		
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 practicable, search terms used) EPO-Internal, WPI Data		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 544 841 A2 (LG ELECTRONICS INC [KR]) 22 June 2005 (2005-06-22)  paragraph [0021] - paragraph [0037]; figures 1-12 paragraph [0038] - paragraph [0069] -----	1, 2, 10, 14, 15, 17-19, 24, 26, 27
X	EP 0 656 616 A1 (TEXAS INSTRUMENTS INC [US]) 7 June 1995 (1995-06-07)  page 5, line 33 - line 57; claims 1,2,5; figure 7 page 6, line 26 - line 34 page 4, line 21 - line 23 -----	1, 2, 10, 14, 15, 17-19, 24, 26, 27
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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 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	
4 April 2012	19/09/2012	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Gartlan, Michael	

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2012/027879

## Box No. 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 No. 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 fees, this Authority did not invite payment of additional fees.
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, 2, 10, 14, 15, 17-19, 24, 26, 27

### Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- 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, 2, 10, 14, 15, 17-19, 24, 26, 27

the current frame stream comprises two frames to allow a simple detection of type of incoming stream

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2. claims: 3, 28

the current frame stream comprises more than two frames to avoid jerking artifacts resulting from mode changes.

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3. claims: 4, 7, 11, 13

updating the electronic display by line multiplying to increase the frame update rate.

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4. claims: 5, 30

if the current frame stream is dynamic the dithering method selected utilizes a noise signal that has a radially asymmetric frequency spectrum around zero frequency to optimise the video display performance

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5. claims: 6, 31

if the current frame stream is static the dithering method selected utilizes either Floyd-Steinberg error-diffusion to improve the display accuracy of still images

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6. claims: 8, 12, 25, 29

quantizing the dithered frame to allow broader support of different panel types

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7. claim: 9

the current frame has a color depth greater than the color depth of the displayed image data to allow reduction of display panel cost

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8. claim: 16

a controller configured to send at least a portion of the image data to the driver circuit to minimise power required to update a frame.

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

9. claims: 20-23

the dithering method is chosen based on a frame update rate  
to allow smoother motion.

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2012/027879

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
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