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(54) **SYSTEM AND METHOD FOR PRESENTING IMAGE CONTENT ON MULTIPLE DEPTH PLANES BY PROVIDING MULTIPLE INTRA-PUPIL PARALLAX VIEWS**

(57) A head-mounted display system (60) and corresponding method, comprising a light source (1026) comprising a plurality of spatially distinct light output locations; a spatial light modulator (1018) configured to modulate light from the light source (1026); and projection optics (1020) configured to direct light from the spatial light modulator (1018) for propagation into an eye (210) of a viewer, wherein the display system is configured to display a virtual object on a depth plane by injecting a set of parallactically-disparate intra-pupil images of the virtual object into the eye (210) of the viewer, wherein injecting the set of parallactically-disparate intra-pupil images comprises changing a path of light from the light source (1026) to the spatial light modulator (1018) by activating different ones of the light output locations to increase a magnitude of parallax disparity between the parallactically-disparate intra-pupil images as the virtual object decreases in perceived distance to the viewer.

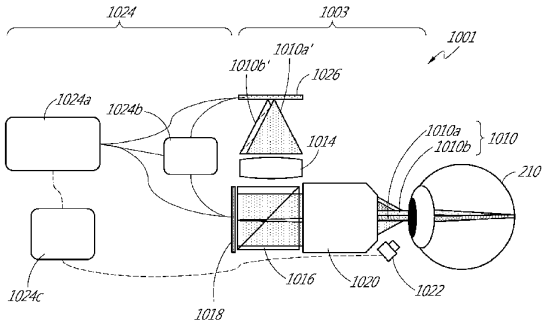

FIG. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 24 15 2541

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	SUNG-KYU KIM: "Full parallax multifocus three-dimensional display using a slanted light source array", OPTICAL ENGINEERING., vol. 50, no. 11, 1 November 2011 (2011-11-01), page 114001, XP055695881, BELLINGHAM ISSN: 0091-3286, DOI: 10.1117/1.3643728 * abstract; sections "2 System Laout Using a Slanted Light Soure Array" and "4 Conclusion; figures 1,2 *	1-15	INV. G02B27/01 G06T19/00 G02B30/40 H04N13/344 H04N13/128 H04N13/398 H04N13/383
A	SUNG-KYU KIM AND DONG WOOK KIM: "Development of three types of multi-focus 3D display", SPIE, PO BOX 10 BELLINGHAM WA 98227-0010, USA, 19 May 2011 (2011-05-19), XP040559995, DOI: https://doi.org/10.1117/12.883609 * abstract; figures 2,5 * * page 2 - page 5 *	1-15	TECHNICAL FIELDS SEARCHED (IPC) G02B
A	Andrew Maimone ET AL: "High Efficiency Near-Eye Light Field Display", ACM Trans. Graph. Article, 1 November 2013 (2013-11-01), XP055433360, Retrieved from the Internet: URL:https://www.cs.unc.edu/~maimone/media/Maimone_GTC2015.pdf [retrieved on 2020-05-15] * sections "1. Abstract" and "3. Method & Results"; figures 1, 2, 4, 5 *	1-15	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 April 2024	Kaiser, Peter

CATEGORY OF CITED DOCUMENTS

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Application Number
EP 24 15 2541

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	TSUBASA KANEBAKO ET AL: "Time-multiplexing display module for high-density directional display", SPIE - INTERNATIONAL SOCIETY FOR OPTICAL ENGINEERING. PROCEEDINGS, vol. 6803, 14 February 2008 (2008-02-14), page 68030P, XP055692422, US ISSN: 0277-786X, DOI: 10.1117/12.767881 ISBN: 978-1-5106-3377-3 * abstract; figures 1, 2, 4, 5; table 2 * * sections "2. HIGH-DENSITY DIRECTIONAL IMAGE" and "7. Conclusions" * -----	1-15	
A	US 2015/205259 A1 (KIM HYUN EUI [KR] ET AL) 23 July 2015 (2015-07-23) * paragraphs [0045] - [0050], [0056] - [0060]; figures 1,4,5 * -----	1-15	
A	JP 2002 228978 A (MIXED REALITY SYSTEMS LAB INC) 14 August 2002 (2002-08-14) * paragraphs [0002] - [0005]; figures 21-23 * -----	1-15	TECHNICAL FIELDS SEARCHED (IPC)
A	US 2015/178939 A1 (BRADSKI GARY R [US] ET AL) 25 June 2015 (2015-06-25) * paragraphs [0008] - [0014], [0133], [0134]; figures 13G, 13H * -----	7	

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11-04-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2015205259 A1	23-07-2015	KR 20150086799 A	29-07-2015
		US 2015205259 A1	23-07-2015
JP 2002228978 A	14-08-2002	NONE	
US 2015178939 A1	25-06-2015	NONE	

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