



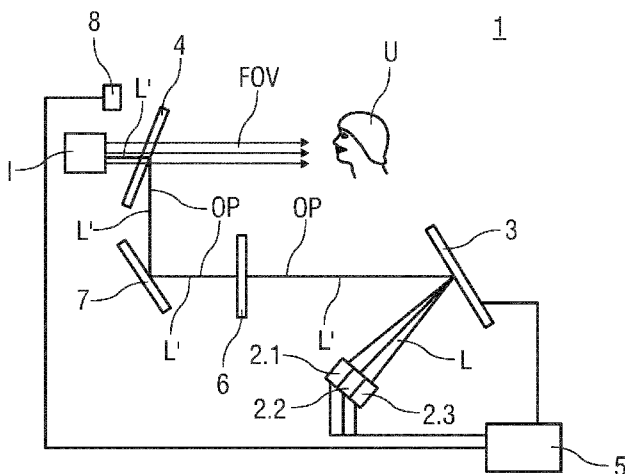
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(54) Title: HEAD-UP DISPLAY AND METHOD FOR OPERATING IT

FIG 1



(57) Abstract: The invention relates to a head-up display (1) comprising: - at least three light sources (2.1, 2.2, 2.3), each one arranged to emit light (L) with a basic colour different from the basic colour of the other light sources (2.1, 2.2, 2.3), - a digital micro mirror device (3) comprising an array of micro mirrors, wherein the light (L) of the light sources (2.1, 2.2, 2.3) is directed onto the digital micro mirror device (3), - at least one combiner (4) for displaying an image (I), and - at least one control unit (5) for multiplexing the light sources (2.1, 2.2, 2.3) so as to sequentially emit light (L) thus creating a field-sequential colour system and for controlling the digital micro mirror device (3) so as to selectively rotate the micro mirrors between an on state, where the light (L) from the light sources (2.1, 2.2, 2.3) is reflected into an optical path (OP) towards the combiner (4), and an off state, where the light (L) is reflected away from that optical path (OP). The invention also relates to a method for operating the head-up display (1).

WO 2014/016329 A1

Head-up display and method for operating it

Description

The invention relates to a head-up display and to a method for operating the head-up display.

Head-up displays are devices which transparently display information into a view field of a user, basically without obscuring the scene within that view field so that the user may remain focussed on that scene and also acquire the displayed information. Head-up displays may for example be used in vehicles or aircraft.

Conventional head-up displays may comprise a thin film transistor (TFT) display, illuminated by a light source, which may comprise high power LEDs.

WO 2006/013523 A2 discloses a projection system including a light source, an imaging surface and a saturable absorber between the light source and the imaging surface. The projection system may be a scanning projection system. In another embodiment the projection system may include a light valve such as a liquid crystal panel.

WO 2008/075530 A1 discloses a head-up display device including a plurality of display means which emit visible lights, which are reflected towards a user by a combiner member, e.g. a wind shield, so as to form virtual images. The head-up display device includes a micro mirror device having a plurality of micro plane mirrors aligned in such a manner that each of the mirrors can move. The micro mirror device controls the visible lights emitted from the display means into a direction for forming the display

images by adjusting the angle of the plane mirrors at a predetermined time interval or individually.

It is an object of the present invention to provide an improved head-up display and an improved method for operating the head-up display.

The object is achieved by a head-up display according to claim 1 and by a method according to claim 16.

Preferred embodiments of the invention are given in the dependent claims.

According to the invention the head-up display comprises:

- at least three light sources, each one arranged to emit a basic colour different from the basic colour of the other light sources,
- a digital micro mirror device comprising an array of micro mirrors, wherein the light of the light sources is directed onto the digital micro mirror device,
- at least one combiner for displaying an image, and
- at least one control unit for multiplexing the light sources so as to sequentially emit light thus creating a field-sequential colour system and for controlling the digital micro mirror device so as to selectively rotate the micro mirrors between an on state, where the light from the light sources is reflected into an optical path towards the combiner, and an off state, where the input light is reflected away from that optical path.

A method for operating a head-up display according to the invention comprises:

- multiplexing at least three light sources, each one arranged to emit a basic colour different from the basic colour of the other light sources, so as to sequentially emit light onto a digital micro mirror device (DMD) comprising an array of micro mirrors, thus creating a field-sequential colour system,

- controlling the digital micro mirror device so as to selectively rotate the micro mirrors between an on state, where the light from the light sources is reflected into an optical path towards a combiner for displaying an image, and an off state, where the input light is reflected away from that optical path.

The light sources, e.g. LEDs are high speed controlled and multiplexed so as to sequentially emit light in order to sequentially display images in the respective basic colour, e.g. red, green or blue, at such a rate that the inertia of the human vision creates the impression of a colour picture mixed by the three colours. This approach is referred to as a field-sequential colour system. Furthermore, the head-up display comprises the digital micro mirror device (DMD) comprising an array of micro mirrors corresponding to pixels of an image to be created.

As opposed to conventional head-up displays with TFT imaging, which typically have a low optical efficiency with TFT transmission rates in the range of 4% to 5%, the optical efficiency of the head-up display according to the invention is considerably increased. Digital micro mirror devices have an average optical efficiency of 50% to 60% allowing for global optical system efficiencies around 25%, thus dividing the need for the input optical power of the light sources by a factor of around 5 to 6. Lower input optical power results in lower thermal dissipation by the light source and hence reduced effort for cooling and reduced requirements to heat resistance of the components of the head-up display and surrounding components in the mounting location. The head-up display according to the invention also allows for higher contrast ratios and thus better readability in all ambient lighting conditions as well as greater image sizes.

An intermediate screen may be arranged in the optical path for shaping the light reflected from the digital micro mirror device so as to reproduce the

image on the combiner. The intermediate screen may be adapted to transmit or reflect the light reflected from the digital micro mirror device.

The intermediate screen may comprise a polymer material, e.g. optical grade polycarbonate, cyclic olefin copolymer or cyclo-olefin polymer. Thus, a less expensive head-up display may be achieved as opposed to conventional head-up displays employing glass lenses for shaping the light.

The intermediate screen may comprise micro-structures for shaping the optical path. The micro-structures may comprise micro-optical lenses arranged in regular or random/stochastic patterns. Furthermore, the intermediate screen may comprise at least one coating.

In an embodiment of the invention at least one mirror may be arranged for folding the optical part. This allows for a compact design of the head-up display in complex installation situations.

The combiner and/or the mirror may be made of glass or of plastics, e.g. optical grade polycarbonate, cyclic olefin copolymer or cyclo-olefin polymer, in order to further reduce costs.

The combiner and/or the mirror may comprise/comprises an optically effective coating. The coating may be arranged for enhancing the reflectivity of the combiner and/or mirror in the visible spectrum. For example, the reflectivity may be enhanced from 20 % to 95 %, depending on the product type and the application.

The combiner may be a windshield of a vehicle or a separate transparent component arranged or arrangeable in the field of view of the user, e.g. a driver of the vehicle.

The head-up display may comprise one or more fixed combiners or one or more combiners with a mechanical tilt which may be manually operated by a user. Likewise, the head-up display may comprise one or more drive units or kinematic modules which may electrically, pneumatically or hydraulically move the combiner or mirror into and out of the field of view. This movement may be controlled by user operation and/or automatically, e.g. if important information such as engine problems, low oil or coolant pressure or level etc. are to be brought to the user's attention.

In an exemplary embodiment a sensor may be arranged for acquiring ambient light conditions, wherein the control unit is arranged to adapt a brightness of the image depending on the ambient light conditions.

The sensor may have a logarithmic sensitivity with a fine sensitivity in dark light conditions and a coarse sensitivity in bright ambient light. This allows for improving the adaption of the brightness of the head-up display.

The control unit may be arranged to adapt the brightness of the image by controlling a power of the light sources and/or by applying a pulse width modulation to the digital micro mirror device.

Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

Brief Description of the Drawings

The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus, are not limitive of the present invention, and wherein:

Figure 1 is a schematic view of a head-up display.

Detailed Description of Preferred Embodiments

Figure 1 is a schematic view of a head-up display 1. The head-up display 1 comprises three light sources 2.1, 2.2., 2.3, each one arranged to emit light L in one of the basic colours red, green or blue, wherein the basic colour of each light source 2.1, 2.2, 2.3 is different from the basic colour of the others. Furthermore, the head-up display 1 comprises a digital micro mirror device 3 comprising an array of micro mirrors, wherein the light L of the light sources 2.1, 2.2, 2.3 is directed onto the digital micro mirror device 3. Moreover, the head-up display 1 comprises a combiner 4 for displaying an image I. A control unit 5 is arranged for multiplexing the light sources 2.1, 2.2, 2.3 so as to sequentially emit light L thus creating a field-sequential colour system and for controlling the digital micro mirror device 3 so as to selectively rotate the micro mirrors between an on state, where the light L from the light sources 2.1, 2.2, 2.3 is reflected into an optical path OP towards the combiner 4 thus creating the image I, and an off state, where the input light L is reflected away from that optical path OP so that it is not displayed by the combiner 4. The combiner 4 is arranged in the field of view FOV of a user U, e.g. a driver of a vehicle or an operator of an aircraft.

The image I may be created in or on the combiner 4 or, as illustrated, reflected by the combiner 4 such that the user U perceives the image I at a distance behind the combiner 4. In this case the combiner 4, although basically transparent, is arranged as a mirror, however with a reflectance considerably below total reflection. The combiner may be flat, convex, concave or free-form.

An intermediate screen 6 is arranged in the optical path OP for shaping the light L' reflected from the digital micro mirror device 3. For this purpose, the intermediate screen 6 is shaped as a lens or comprises micro-structures (not illustrated) for shaping the light L' in the optical path OP so as to create the image I. The intermediate screen 6 may be made of or comprise glass or plastics, e.g. a polymer material. In the illustrated embodiment the intermediate screen 6 is adapted to transmit the light L' reflected from the digital micro mirror device 3. In an alternative embodiment (not illustrated) the intermediate screen 6 may be adapted to reflect the light L' reflected from the digital micro mirror device 3.

A mirror 7 is arranged for folding the optical part OP. In alternative embodiments the optical path OP may be folded by more than one mirror 7. The mirror 7 may be flat, concave or convex in order to adjust the size of the image I. The mirror 7 or at least one of the mirrors 7 may be arranged to be tilted (not illustrated) for adjusting the position of the image I within the field of view.

A sensor 8 is arranged for acquiring ambient light conditions, wherein the control unit 5 is arranged to adapt a brightness of the image I depending on the ambient light conditions. The sensor 8 may have a logarithmic sensitivity.

The brightness of the image I may be adapted by adjusting an input power of the light sources 2.1, 2.2, 2.3 thereby controlling the power of the emitted light L and/or by applying a pulse width modulation to the digital micro mirror device 3.

The combiner 4 and/or the mirror 7 may be made of plastics or glass and be equipped with an optically effective coating.

A drive unit or kinematic (not illustrated) may be arranged for selectively moving, e.g. folding the combiner 4 into or out of the field of view FOV.

In an exemplary embodiment the combiner 4 is a windshield of a vehicle.

List of References

- 1 head-up display
- 2.1 light source
- 2.2 light source
- 2.3 light source
- 3 digital micro mirror device
- 4 combiner
- 5 control unit
- 6 intermediate screen
- 7 mirror
- 8 sensor
- FOV field of view
- I image
- L light
- L' light
- OP optical path
- U user

Claims

1. Head-up display (1) comprising:
 - at least three light sources (2.1, 2.2, 2.3), each one arranged to emit light (L) with a basic colour different from the basic colour of the other light sources (2.1, 2.2, 2.3),
 - a digital micro mirror device (3) comprising an array of micro mirrors, wherein the light (L) of the light sources (2.1, 2.2, 2.3) is directed onto the digital micro mirror device (3),
 - at least one combiner (4) for displaying an image (I), and
 - at least one control unit (5) for multiplexing the light sources (2.1, 2.2, 2.3) so as to sequentially emit light (L) thus creating a field-sequential colour system and for controlling the digital micro mirror device (3) so as to selectively rotate the micro mirrors between an on state, where the light (L) from the light sources (2.1, 2.2, 2.3) is reflected into an optical path (OP) towards the combiner (4), and an off state, where the light (L) is reflected away from that optical path (OP).
2. Head-up display (1) according to claim 1, characterized in that an intermediate screen (6) is arranged in the optical path (OP) for shaping the light (L') reflected from the digital micro mirror device (3).
3. Head-up display (1) according to claim 2, characterized in that the intermediate screen (3) comprises a polymer material.
4. Head-up display (1) according to one of the claims 2 or 3, characterized in that the intermediate screen (6) comprises micro-structures for shaping the optical path (OP).

5. Head-up display (1) according to one of the preceding claims, characterized in that at least one mirror (7) is arranged for folding the optical part (OP).
6. Head-up display (1) according to one of the preceding claims, characterized in that the combiner (4) and/or the mirror (7) comprise/comprises plastics.
7. Head-up display (1) according to one of the claims 1 to 5, characterized in that the combiner (4) and/or the mirror (7) comprise/comprises glass.
8. Head-up display (1) according to one of the preceding claims, characterized in that the combiner (4) and/or the mirror (7) comprise/comprises an optically effective coating.
9. Head-up display (1) according to one of the preceding claims, characterized in that the combiner (4) is a transparent component arranged or arrangeable in the field of view (FOV) of a user (U).
10. Head-up display (1) according to claim 9, characterized in that a drive unit is arranged for selectively moving the combiner (4) into or out of the field of view (FOV).
11. Head-up display (1) according to claim 9, characterized in that the combiner (4) is a windshield of a vehicle.
12. Head-up display (1) according to one of the preceding claims, characterized in that a sensor (8) is arranged for acquiring ambient light conditions, wherein the control unit (5) is arranged to adapt a brightness of the image (I) depending on the ambient light conditions.

13. Head-up display (1) according to claim 12, characterized in that the sensor (8) has a logarithmic sensitivity.
14. Head-up display (1) according to one of the claims 12 or 13, characterized in that the control unit (5) is arranged to adapt the brightness of the image (I) by controlling a power of the light sources (2.1, 2.2, 2.3) and/or by applying a pulse width modulation to the digital micro mirror device (3).
15. Head-up display (1) according to one of the claims 2 to 14, wherein the intermediate screen (6) is adapted to transmit or reflect the light (L') reflected from the digital micro mirror device (3).
16. Method for operating a head-up display (1), the method comprising:
 - multiplexing at least three light sources (2.1, 2.2, 2.3), each one arranged to emit light (L) with a basic colour different from the basic colour of the other light sources (2.1, 2.2, 2.3), so as to sequentially emit light (L) onto a digital micro mirror device (3) comprising an array of micro mirrors, thus creating a field-sequential colour system,
 - controlling the digital micro mirror device (3) so as to selectively rotate the micro mirrors between an on state, where the light (L) from the light sources (2.1, 2.2, 2.3) is reflected into an optical path (OP) towards a combiner (4) for displaying an image (I), and an off state, where the input light (L) is reflected away from that optical path (OP).

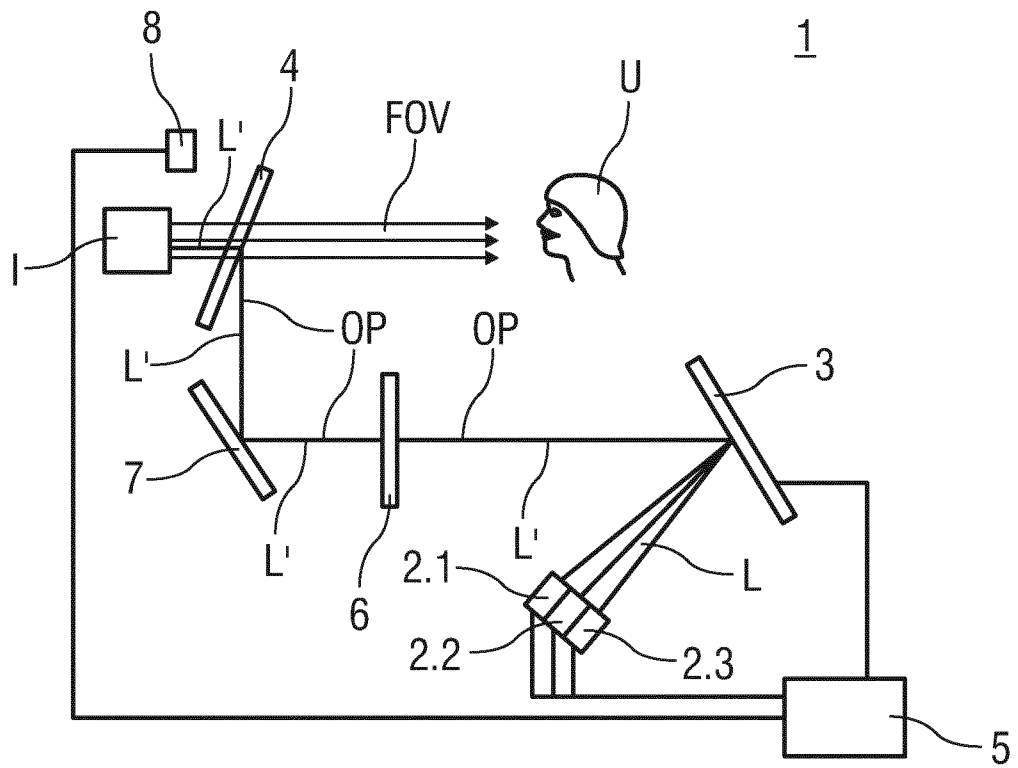


FIG 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2013/065584

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.:

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.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/065584

A. CLASSIFICATION OF SUBJECT MATTER
INV. G02B27/01
ADD.

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2006 013140 A1 (SIEMENS AG [DE]) 27 September 2007 (2007-09-27)	1,2,4-7, 9,11,15, 16
Y	abstract paragraph [0020] - paragraph [0026] figures 1-5	3,8,10, 12-14
Y	----- US 2005/200962 A1 (VOLOSCHENKO DMITRY [US] ET AL) 15 September 2005 (2005-09-15) paragraph [0017] - paragraph [0021] figure 1	3
X	----- US 2004/066547 A1 (PARKER WILLIAM [US] ET AL) 8 April 2004 (2004-04-08) abstract paragraph [0062] - paragraph [0065] figure 5 ----- -/--	1,2,9, 11,16

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 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 24 September 2013	Date of mailing of the international search report 02/10/2013
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 Schenke, Cordt

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/065584

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2005/012682 A1 (JENSON BARTON JAMES [US] ET AL) 20 January 2005 (2005-01-20) abstract paragraph [0026] figure 3	8
Y	----- US 2007/279755 A1 (HITSCHMANN GUIDO [DE] ET AL) 6 December 2007 (2007-12-06) abstract paragraph [0033] figure 5	8
Y	----- WO 2011/147501 A2 (JOHNSON CONTROLS GMBH [DE]; LUDEWIG BERND [DE]; HERVY SEBASTIEN [FR]) 1 December 2011 (2011-12-01) abstract page 4, paragraph 3	8
Y	----- US 2008/285138 A1 (LEBRETON ETIENNE [FR]) 20 November 2008 (2008-11-20) abstract paragraph [0036] - paragraph [0044] figures 1-3	10
Y	----- EP 2 093 603 A1 (SAAB AB [SE]) 26 August 2009 (2009-08-26) abstract paragraph [0027] - paragraph [0045] figure 1b	12-14
Y	----- WO 2004/071074 A1 (BOSCH GMBH ROBERT [DE]; SEGER ULRICH [DE]; SCHICK JENS [DE]) 19 August 2004 (2004-08-19) abstract page 3, line 2 - line 7	13

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/EP2013/065584

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102006013140 A1	27-09-2007	DE 102006013140 A1 WO 2007107515 A1	27-09-2007 27-09-2007

US 2005200962 A1	15-09-2005	NONE	

US 2004066547 A1	08-04-2004	NONE	

US 2005012682 A1	20-01-2005	US 2005012682 A1 WO 2005010569 A2	20-01-2005 03-02-2005

US 2007279755 A1	06-12-2007	NONE	

WO 2011147501 A2	01-12-2011	CN 103003736 A EP 2577379 A2 US 2013182197 A1 WO 2011147501 A2	27-03-2013 10-04-2013 18-07-2013 01-12-2011

US 2008285138 A1	20-11-2008	AT 480420 T BR PI0619694 A2 CN 101346253 A EP 1948465 A1 ES 2350857 T3 FR 2893553 A1 JP 5020252 B2 JP 2009515768 A PT 1948465 E US 2008285138 A1 WO 2007057608 A1	15-09-2010 11-10-2011 14-01-2009 30-07-2008 27-01-2011 25-05-2007 05-09-2012 16-04-2009 21-10-2010 20-11-2008 24-05-2007

EP 2093603 A1	26-08-2009	AT 521010 T EP 2093603 A1 ES 2368463 T3 JP 2009199082 A US 2009213037 A1	15-09-2011 26-08-2009 17-11-2011 03-09-2009 27-08-2009

WO 2004071074 A1	19-08-2004	DE 10305010 A1 EP 1595391 A1 JP 4204558 B2 JP 2006515130 A US 2007023660 A1 WO 2004071074 A1	02-09-2004 16-11-2005 07-01-2009 18-05-2006 01-02-2007 19-08-2004

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-16

Head-up display comprising at least three light sources, each one arranged to emit light with a basic colour different from the basic colour of the other light sources, a digital micro mirror device comprising an array of micro mirrors, wherein the light of the light sources is directed onto the digital micro mirror device, at least one combiner for displaying an image, and at least one control unit for multiplexing the light sources so as to sequentially emit light thus creating a field-sequential colour system and for controlling the digital micro mirror device so as to selectively rotate the micro mirrors between an on state, where the light from the light sources is reflected into an optical path towards the combiner, and an off state, where the light is reflected away from that optical path,

1.1. claims: 1-7, 9, 11, 15, 16

further comprising an intermediate screen arranged in the optical path for shaping the light reflected from the digital micro mirror device, said intermediate screen comprising a polymer material.

1.2. claim: 8

wherein the combiner and/or the mirror comprise an optically effective coating.

1.3. claim: 10

further comprising a drive unit arranged for selectively moving the combiner into or out of the field of view.

1.4. claims: 12-14

further comprising a sensor arranged for acquiring ambient light conditions, wherein the control unit is arranged to adapt a brightness of the image depending on the ambient light conditions.
