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(54) Title: VISUALIZATION SYSTEM,VEHICLE AND METHOD FOR OPERATING A VISUALIZATION SYSTEM

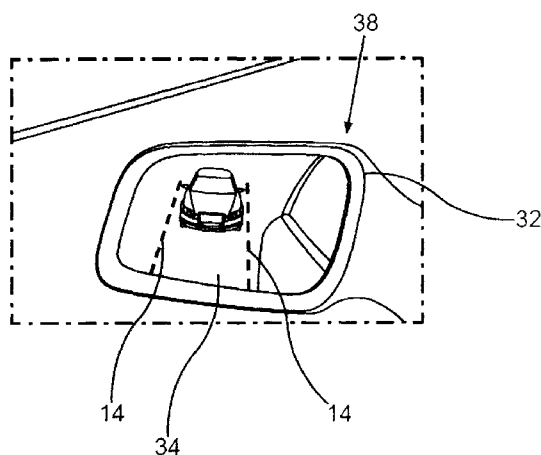


Fig.3

(57) Abstract: The invention relates to a visualization system for a vehicle comprising at least one vision device (38) which is configured to show at least a section of the vehicle's surroundings. A sensor is configured to detect at least one object (14) in the section of the vehicle's surroundings. The visualization systems further comprises a positioning device configured to determine a position at least of a part of the driver's head within the vehicle relative to the at least one vision device (38). A control unit of the visualization system is configured to operate visualizing means in order to visualize the at least one object (14) in an orientation taking into account this position. The invention further relates to a vehicle with such a visualization system and to a method for operating a visualization system.

VISUALIZATION SYSTEM, VEHICLE AND METHOD FOR OPERATING A VISUALIZATION SYSTEM

Field of the Invention

The invention relates to a visualization system for a vehicle, which comprises at least one vision device. The vision device is configured to show at least a section of the vehicle's surroundings. A sensor of the visualization system is configured to detect at least one object in the section of the vehicle's surroundings. The visualization system also comprises means for visualizing the at least one object in the at least one vision device. The invention further relates to a vehicle with such a visualization system and to a method for operating a visualization system for a vehicle.

Background Art

Document US 2013/0063598 A1 describes a rear-view mirror for a vehicle, in which an image capture unit is integrated. Images captured by the image capture unit can be displayed on an image display apparatus which is arranged on a mirror surface of the rear-view mirror. The image display apparatus can be a liquid crystal display or a light emitting diode screen.

Side-view mirrors with a display which is arranged behind a reflective element of the side-view mirror are also described in US 2012/0326888 A1 and DE 10 2011 113 640 A1. In US 2012/0326888 A1 a presence of an object in a blind spot of the mirror and a turn signal indicator are displayed in the side-view mirror. In DE 10 2011 113 640 A1 navigation instructions are displayed in the side-view mirror.

Further US 2010/0271190 A1 describes a mirror which is installed at a road. The mirror includes a camera and an indicating module. Depending on the road condition which is detected by the camera signs or messages can be displayed by the indicating module such as a request to slow down.

Still further WO 2007/018145 A1 describes a pavement marking recognition system which is configured to determine whether a pavement marking is worn or in good condition.

Summary of the Invention

It is an object of the present invention to provide a visualization system, a vehicle and a method of the initially mentioned type, which provides for enhanced road safety.

This object is solved by a visualization system having the features of claim 1, a vehicle having the features of claim 9 and a method having the features of claim 10. Advantageous embodiments with convenient developments of the invention are specified in the dependent claims.

According to the invention the visualization system comprises a positioning device which is configured to determine a position at least of a part of a driver's head within the vehicle relative to the at least one vision device. A control unit of the visualization system is configured to operate the visualizing means in order to visualize the at least one object in an orientation which takes into account this position. By taking into account the position of the driver's head the control unit thus assures that the object detected in the vehicle's surroundings by the sensor is shown in the vision device at the correct position. This is based on the finding that by doing so the object can be visualized in the vision device in a way which helps the driver in correctly localizing the object in the vehicle's surroundings.

The visualization system is thus configured to visualize the object in a first orientation if the driver's head is in a first position relative to the vision device and in a second orientation if the driver's head is in a second position relative to the vision device. Thus differences in drivers' sizes or postures can be taken into account when visualizing the object in the vision device. It is for example taken into account if the driver's head is further away or closer to a steering wheel or a headrest of the driver's seat. Therefore if the driver's head moves within the vehicle, the means for visualizing change the orientation of the object shown in the vision device accordingly. As this helps the driver in realizing objects in the vehicle's surroundings, road safety is increased by the visualization system.

In an advantageous embodiment the positioning device comprises a unit which is configured to determine a position of at least one eye of the driver. This further enhances accuracy when showing the object in the correct orientation. Also such a unit, for example an eye tracking device such as a camera, is readily available, reliable and can be easily implemented in the visualization system.

It has further proven to be advantageous if the positioning device comprises a unit configured to determine an inclination about a horizontal axis and/or about a vertical axis of the at least one vision device. Thus varying the inclination of the vision device causes the control unit to operate the means for visualizing in a way which takes into account the change in the inclination of

the vision device. This renders the visualization system particularly flexible and precise.

The means for visualizing the at least one object can be configured to highlight the at least one object with respect to other elements shown in the at least one vision device. Then the driver can in a particularly easy way distinguish the object from the other elements and thus consider the object while driving. The highlighting can be achieved by enhancing a luminosity of the object or of a contour line of the object displayed in the vision device. Alternatively or additionally the object or its contours can be broadened, or a striking colour can be utilized to visualize the object or the object's contours. Such highlighting measures to an improved visual perception of the object by the driver looking at the vision device.

It is particularly helpful if the means for visualizing are configured to highlight road surface markings such as lane markings in the at least one vision device. Especially on roads with multiple lanes it is difficult to distinguish on which lanes surrounding cars drive. This is in particular true when driving by night or when the sight is limited by fog or the like. Thus visualizing highlighted lane markings enhances road safety when driving on roads with multiple lanes.

The at least one vision device can be designed as a vehicle mirror with a reflective element. Herein the means for visualizing the object is designed as a display arranged within the vehicle mirror. Especially when the driver looks at the vehicle mirror the position of the driver's head has an influence on the orientation in which the object should be visualized in order to show it at the exact position. Thus a particularly useful implementation of the visualization system is provided, if it comprises the vehicle mirror.

Preferably the at least one vehicle mirror is designed as a rear-view mirror and/or as a side-view mirror. Especially when the driver utilizes the rear-view mirror or the side-view mirror to survey the vehicle's surroundings the visualization of objects in the correct orientation within the rear-view mirror or the side-view mirror is particularly helpful. For example it can then be easily distinguished by the driver whether another vehicle in the surroundings is about to overtake or just following the vehicle having the visualization system. This helps the driver in keeping a clear overview of the traffic situation.

The display can be designed as a liquid crystal display (LCD) and/or as a thin-film transistor (TFT) display covered by the reflective element, wherein the reflective element is transmissive for an optical signal generated by the

display. Such an arrangement of the display behind the reflective element allows particularly well to show additional, overlaid information on the reflective element in the correct orientation and at the correct position.

It has also proven advantageous if the at least one vision device is designed as a display configured to display an image captured by a camera and showing at least the section of the vehicle's surroundings. Herein the display is further configured to overlay the image with at least one element representing the at least one object. Such a display is convenient in showing the vehicle's surroundings and the object in the correct orientation in a particularly easy way. Further, if the display is utilized instead of a vehicle mirror located outside a passenger cabin of the vehicle the aerodynamic properties of the vehicle can be improved.

The vehicle according to the invention has a visualization system according to the invention. With such a vehicle improved road safety is achieved.

In the method for operating a visualization system for a vehicle according to the invention at least one vision device shows at least a section of the vehicle's surroundings. At least one object in the section of the vehicle's surroundings is detected by a sensor. The at least one object is visualized in the at least one vision device. The position at least of a part of a driver's head within the vehicle relative to the at least one vision device is determined by a positioning device. The at least one object is visualized in the vision device in an orientation taking into account this position.

By considering the position of the driver's head within the vehicle when visualizing the object, it can be assured that the object is shown to the driver in a way helping him getting a realistic perception of the object's location in the vehicle's surroundings. This leads to improved road safety as the driver is provided with realistic information on the object's orientation and position.

The preferred embodiments presented with respect to the visualization system and the vehicle and the advantages thereof correspondingly apply to the method for operating a visualization system and vice versa.

The features and feature combinations mentioned above in the description as well as the features and feature combinations mentioned below in the description of figures and/or shown in the figures alone are usable not only in the respectively specified combination, but also in other combinations or alone without departing from the scope of the invention.

Brief Description of the Drawings

Further advantages, features and details of the invention are apparent from the claims, the following description of preferred embodiments as well as based on the drawings. Therein show:

- Fig. 1 components of a visualization system for a vehicle, wherein the visualization system is configured to show lane markings in a vehicle mirror in an orientation which takes into account the position of the driver's eyes relative to the vehicle mirror;
- Fig. 2 a side-view mirror on a passenger's side of the vehicle with lane markings shown in the side-view mirror; and
- Fig. 3 a side-view mirror on a driver's side of the vehicle with lane markings shown in the side-view mirror.

Detailed Description of Embodiments of the Invention

Fig. 1 shows components of a visualization system 10 for a vehicle. The visualization system 10 includes an optical sensor such as a camera 12 which captures an image of a road portion. The camera 12 includes an object recognition unit which is configured to detect objects, in particular lane markings 14 in the captured image.

The visualization system 10 also comprises a positioning device 16 with a first unit 18 which is configured to determine a position 20 of the eyes of a driver within the vehicle. This first unit 18 may be an eye tracker which provides the position 20 of the driver's eyes.

The positioning device 16 further comprises a second unit 22 which is configured to determine a position 24 and an inclination of a vehicle mirror such as a side-view mirror 26 (see Fig. 2). The information regarding the lane markings 14, the position 20 of the driver's eyes and the position 24 of the mirror are processed in a control unit 28 of the visualization system 10.

The control unit 28 controls a display 30 which is configured to visualize the lane markings 14 in the side-view mirror 26. The control unit 28 takes into consideration the position 24 and the inclination of the side-view mirror 26 about a horizontal axis, i.e. about a lateral direction of the vehicle and the inclination about a vertical axis of the side-view mirror 26. The control unit 28 also takes into consideration the position 20 of the driver's eyes within the vehicle. Thus the position 20 of the driver's eyes relative to the side-view mirror 26 is determined. With this information and the information on the lane

markings 14 themselves the control unit 28 is able to operate the display 30 in such a way that the lane markings 14 are shown in an orientation on the side-view mirror 26 which take into account this relative position.

Fig. 2 shows the side-view mirror 26 on the passenger's side of the vehicle. The side-view mirror 26 comprises a casing 32 and a reflective layer 34. The reflective layer 34 is transmissive, i.e. semi-permeable for optical signals generated by the display 30. The display 30 is arranged behind the reflective layer 34, and it may be configured as a LCD-screen and/or a TFT-screen. In order to be able to show the lane markings 14 in a great variety of different orientations and locations within the side-view mirror 26 the size of the display 30 preferably is substantially equal to the size of the reflective layer 34. Especially when driving on a road with multiple lanes it is important for the driver to know on which lane the surrounding cars drive. With this information the driver can assess whether a car 36 in the surroundings of the vehicle (see Fig. 2) is overtaking or just following. As this is particularly difficult when driving by night or with limited sight, displaying the lane markings 14 on the side-view mirror 26 helps the driver to distinguish on which lanes the surrounding cars 36 seen in the side-view mirror 26 actually drive.

As the lane markings 14 are highlighted in the side-view mirror 26 this provides better orientation to the driver. The lane markings 14 are displayed in the side-view mirror 26 in the correct orientation and at the right position as the control unit 28 takes into account the position 20 of the driver's eyes and the position 24 and inclination of the side-view mirror 26.

Fig. 3 shows another side-view mirror 38 which is located on the driver's side of the vehicle. This side-view mirror 38 also comprises the casing 32 and the reflective layer 34 which is transmissive for the optical signals generated by the display 30. The display 30 accordingly shows the lane markings 14 detected by the camera 12 in an orientation which takes into account the position 20 of the driver's eyes relative to the side-view mirror 38 on the driver's side of the vehicle.

The lane markings 14 or such additional overlaid information displayed in the side-view mirror 26, 38 are highlighted with respect to other elements visible on the reflective layer 34 of the side-view mirror 26, 38. Thus even in conditions with limited sight the lane markings 14 are clearly visible for the driver looking at each one of the side-view mirrors 26, 38.

The display 30 can be activated automatically for example depending on the visibility conditions in the surroundings of the vehicle. Also the display 30

showing the lane markings 14 at the correct position and in the correct orientation on the side-view mirror 26, 38 can be activated on demand. For example the driver can issue a corresponding command which makes the control unit 28 operate the display 30 accordingly.

Showing the lane markings 14 in the correct orientation by operating the display 30 can also be done in a rear-view mirror (not shown) of the vehicle. Accordingly in such a vehicle mirror the orientation of the lane markings 14 displayed by the display 30 change if the position 20 of the driver's eyes relative to the rear-view mirror or such a vehicle mirror changes.

It is also possible to substitute the reflective layer 34 of the vehicle mirror such as the side-view mirrors 26, 38 by a screen which shows the image captured by the camera 12. On such a screen or display the lane markings 14 can be displayed at the right position and in the correct orientation as the control unit 28 takes into account the position 20 of the driver's eyes relative to the vehicle mirror.

In the visualization system 10 described above the information comprising the position 20 of the driver's eyes, the position 24 and the inclination of the vehicle mirror and the position of the lane markings 14 in the image captured by the camera 12 itself is processed by the control unit 28. It is also possible that the object recognition unit which detects objects in the images captured by the camera 12 is integrated in the control unit 28. The control unit 28 then operates the display 30 based on this information, and the lane markings 14 are shown in vehicle mirrors such as the side-view mirrors 26, 38 in the exact position and orientation.

CLAIMS

1. Visualization system for a vehicle, comprising at least one vision device (26, 38) which is configured to show at least a section of the vehicle's surroundings, a sensor (12) configured to detect at least one object (14) in the section of the vehicle's surroundings and means (30) for visualizing the at least one object (12) in the at least one vision device (26, 38), characterized in that
the visualization system (10) further comprises a positioning device (16) configured to determine a position at least of a part of a driver's head within the vehicle relative to the at least one vision device (26, 38) and a control unit (28) configured to operate the means (30) in order to visualize the at least one object (14) in an orientation taking into account this position.
2. Visualization system according to claim 1,
characterized in that
the positioning device (16) comprises a unit (18) configured to determine a position (20) of at least one eye of the driver.
3. Visualization system according to claim 1 or 2,
characterized in that
the positioning device (16) comprises a unit (22) configured to determine an inclination about a horizontal axis and/or a vertical axis of the at least one vision device (26, 38).
4. Visualization system according to any one of claims 1 to 3,
characterized in that
the means (30) for visualizing the at least one object are configured to highlight the at least one object, in particular at least one road surface marking, especially lane marking (14), with respect to other elements (36) shown in the at least one vision device (26, 38).
5. Visualization system according to any one of claims 1 to 4,
characterized in that
the at least one vision device (26, 38) is designed as a vehicle mirror with a reflective element (34), wherein the means for visualizing the at least one object (14) is designed as a display (30) arranged within the vehicle mirror.

6. Visualization system according to claim 5,
characterized in that
the at least one vehicle mirror is designed as a rear-view mirror and/or
as a side-view mirror (26, 38).
7. Visualization system according to claim 5 or 6,
characterized in that
the display (30) is designed as a liquid crystal display and/or as a thin-
film transistor display covered by the reflective element (34) which is
transmissive for an optical signal generated by the display (30).
8. Visualization system according to any one of claims 1 to 7,
characterized in that
the at least one vision device (26, 38) is designed as a display confi-
gured to display an image captured by a camera (12) and showing at
least the section of the vehicle's surroundings, wherein the display (30)
is further configured to overlay the image with at least one element
representing the at least one object (14).
9. Vehicle with a visualization system (10) according to any one of
claims 1 to 8.
10. Method for operating a visualization system (10) for a vehicle, wherein
at least one vision device (26, 38) shows at least a section of the ve-
hicle's surroundings, at least one object (14) in the section of the ve-
hicle's surroundings is detected by a sensor (12), and the at least one
object (14) is visualized in the at least one vision device (26, 38),
characterized in that
a position at least of a part of a driver's head within the vehicle relative
to the at least one vision device (26, 38) is determined by a positioning
device (16), and the at least one object (14) is visualized in an orienta-
tion taking into account this position.

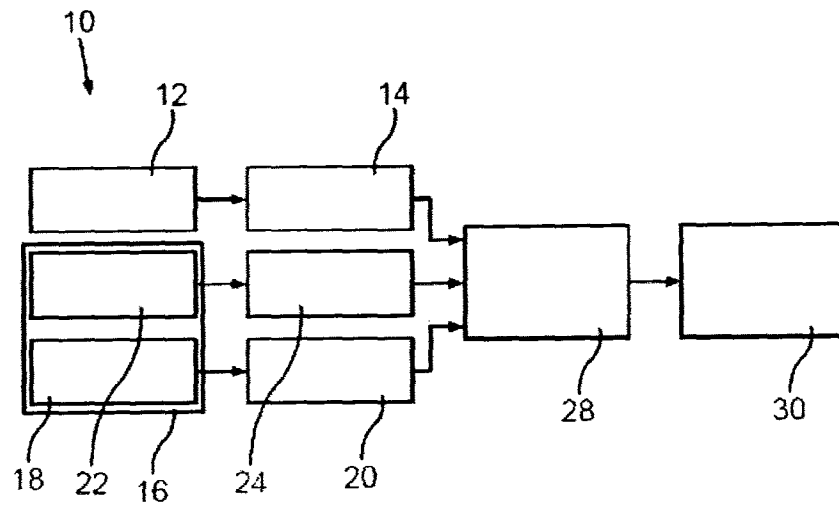


Fig.1

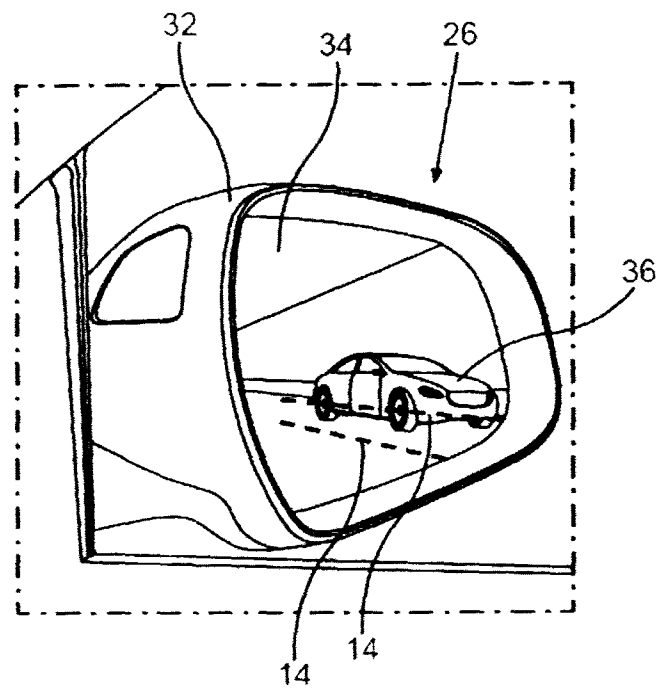


Fig.2

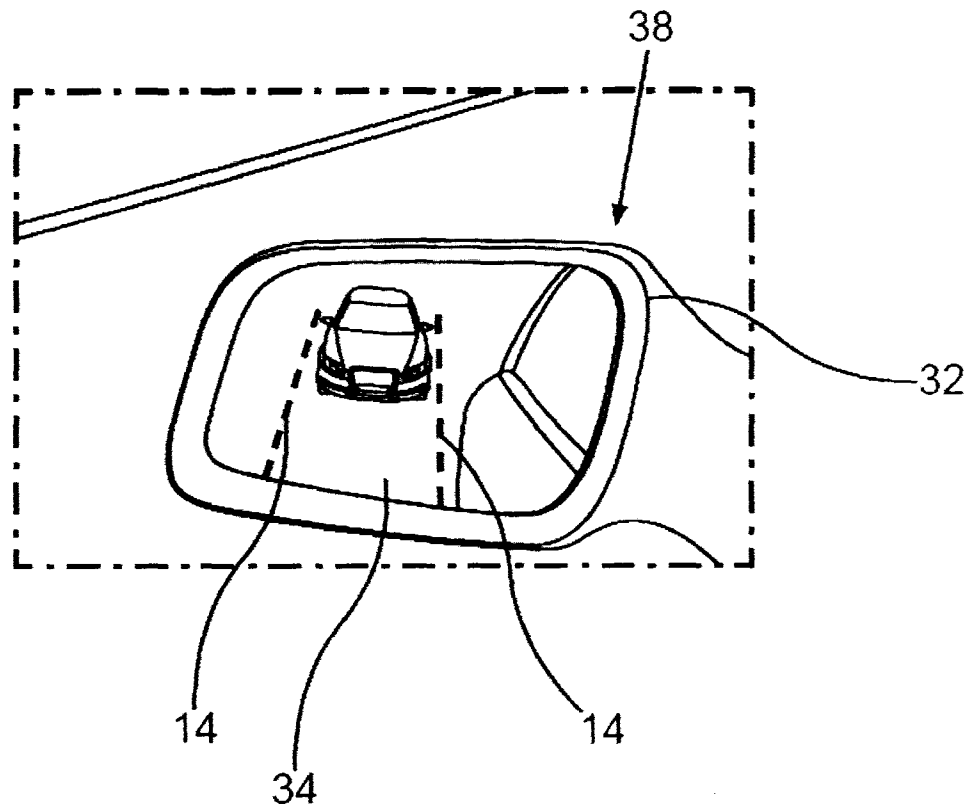


Fig.3

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2013/001855

A. CLASSIFICATION OF SUBJECT MATTER

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ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

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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)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 168 815 A1 (BOSCH GMBH ROBERT [DE]) 31 March 2010 (2010-03-31) paragraph [0008] - paragraph [0017]; figures	1,2,4, 8-10 3,5-7
A	----- DE 103 40 496 A1 (DAIMLER CHRYSLER AG [DE]) 31 March 2005 (2005-03-31) paragraph [0005] - paragraph [0030]; figures	1
A	----- EP 0 455 524 A1 (RENAULT [FR]) 6 November 1991 (1991-11-06) column 3, line 4 - column 5, line 48; figures	1
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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INTERNATIONAL SEARCH REPORT

International 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.
A	US 2011/310001 A1 (MADAU DINU PETRE [US] ET AL) 22 December 2011 (2011-12-22) paragraph [0015] - paragraph [0033]; figures -----	1
A	EP 1 547 866 A1 (SHARP KK [JP]) 29 June 2005 (2005-06-29) paragraph [0041] - paragraph [0085]; figures -----	1
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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