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(54) **SYSTEM FOR ILLUMINATING THE FACE OF AN OCCUPANT IN A CAR**

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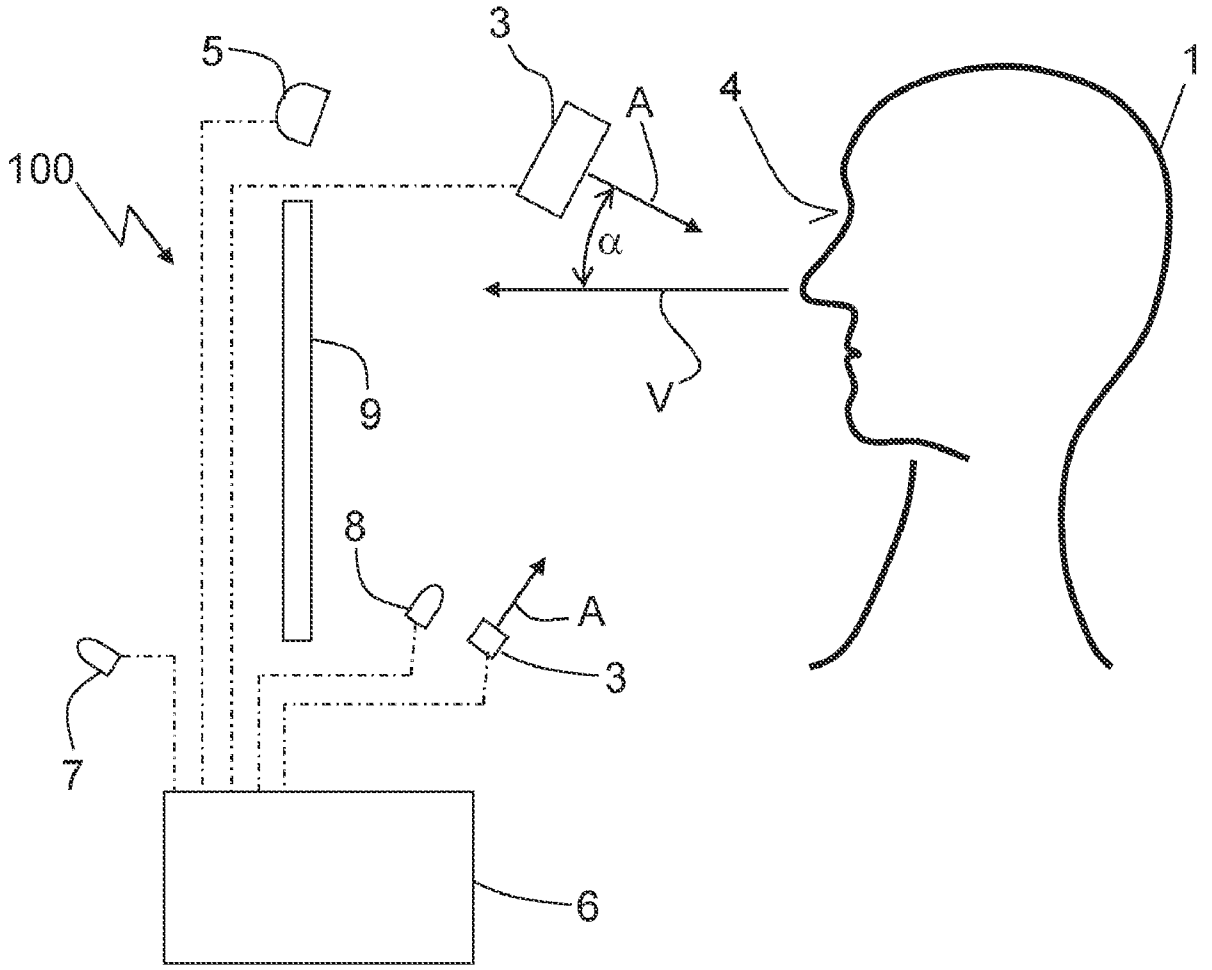
(57) **ABSTRACT**

A system is provided for illuminating the face of an occupant for a video call in a car. At least one light source has a main light emission direction (A) which is directed toward the face of the occupant. The system also includes a camera provided to record the face of the occupant. The system controls the light source in such a way to obtain a flickering free recording of the face of the occupant.



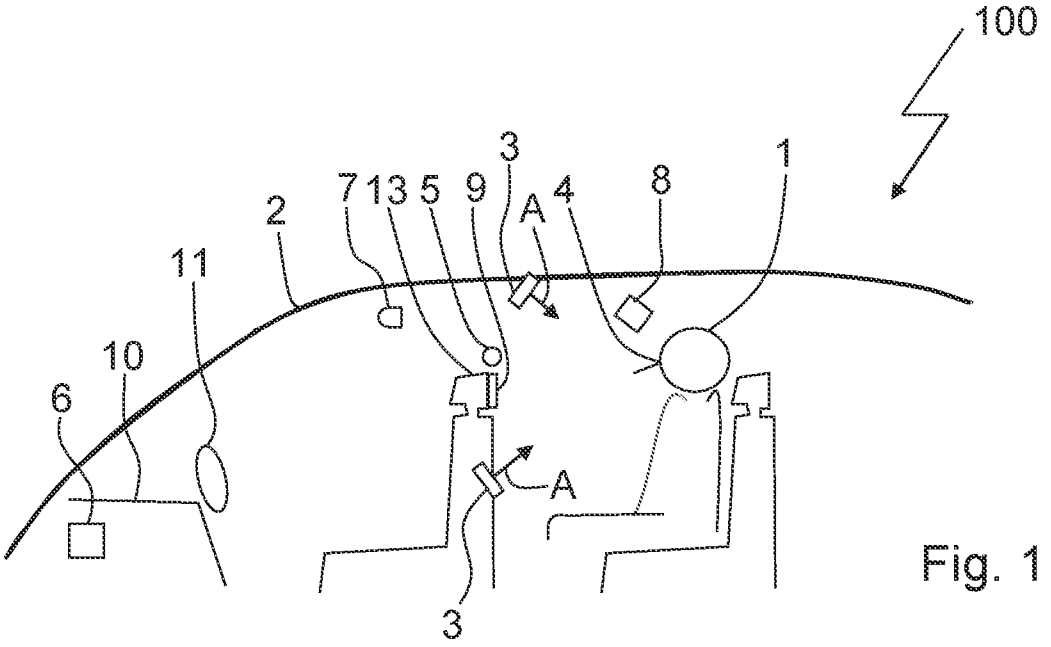


Fig. 1

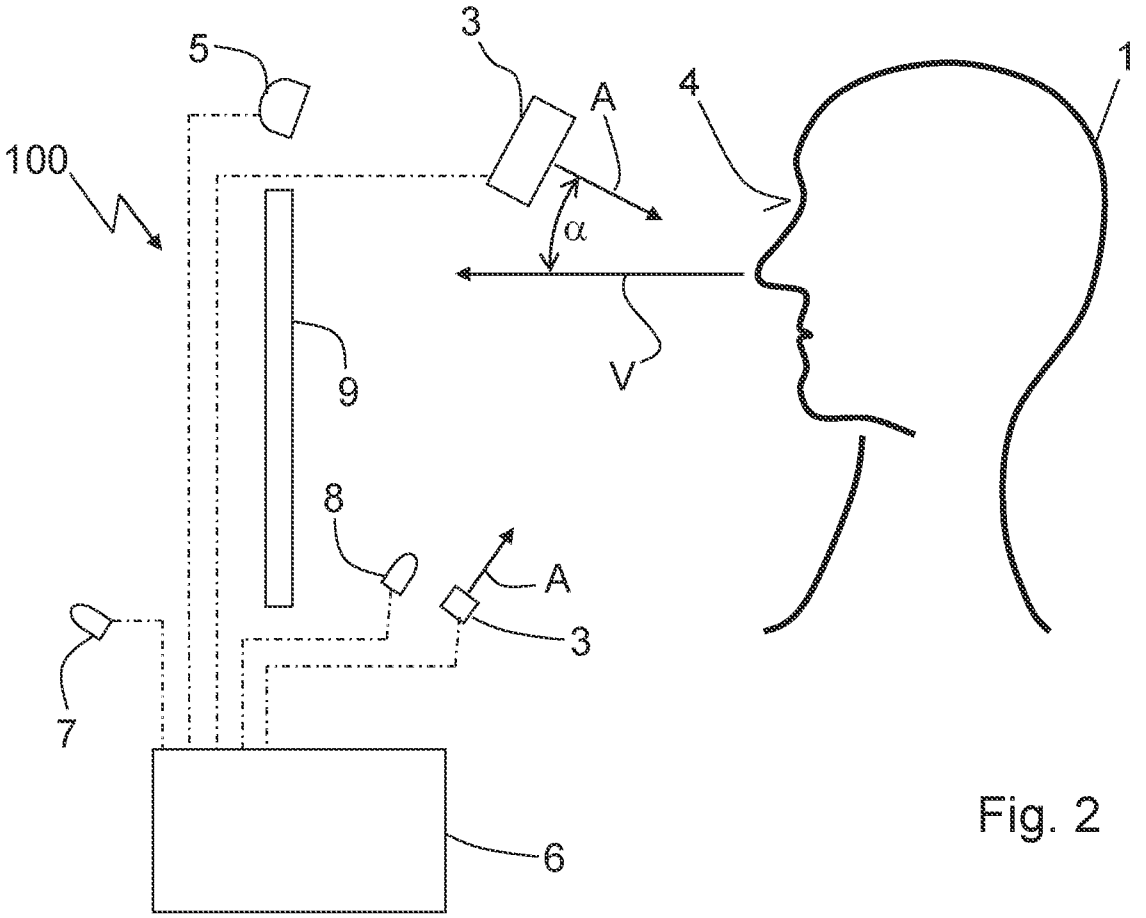


Fig. 2

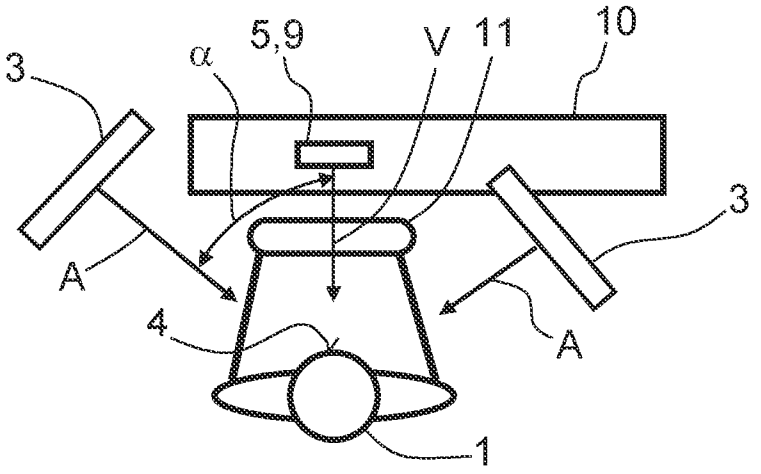


Fig. 3

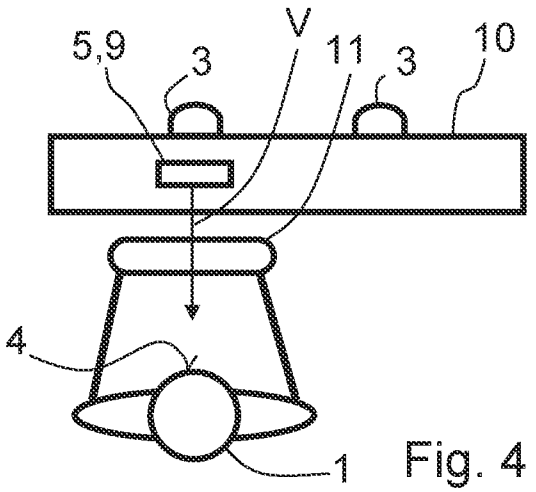


Fig. 4

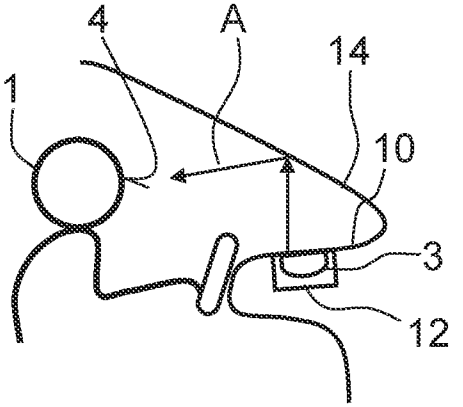


Fig. 5

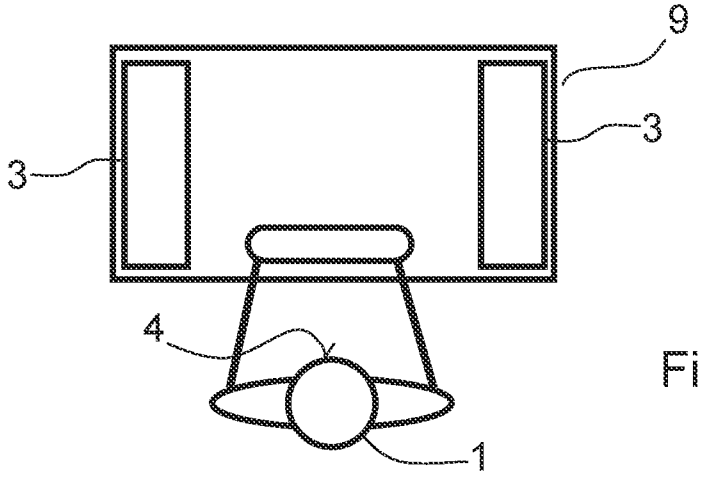


Fig. 6

SYSTEM FOR ILLUMINATING THE FACE OF AN OCCUPANT IN A CAR

CROSS REFERENCE

[0001] This application claims priority to European Application No. 21192574.8, filed Aug. 23, 2021, the entirety of which is hereby incorporated by reference.

FIELD OF THE INVENTION

[0002] The invention relates to a system for illuminating the face of an occupant for a video call in a car, comprising at least one light source, the light source having a main light emission direction which is directed to the face of the occupant.

BACKGROUND OF THE INVENTION

[0003] Document DE 10 2018 215 056 A1 discloses a camera in the vehicle interior of a car, and the camera is thought to take pictures or videos of the occupants.

[0004] Document DE 10 2020 002 847 A1 discloses a system to hold a video conference in the vehicle interior of a car, whereas a camera is installed to record the face of the occupant.

[0005] Usually, the illumination of the face of the occupant is poor inside the interior of a car, in particular when the occupant is the driver of the car or is sitting on the rear seat. When the car is performed to drive semi-autonomous or full-autonomous, the face of the driver must be illuminated in a comfortable and pleasant manner in order to not-blind the driver or any occupant but to illuminate the face in order to obtain a high-quality video recording, at least when the car is not full-autonomous driving.

[0006] Usually, the interior-illumination of a car is not directed to the occupants faces but directed to the leg room, the center console, or the dashboard. The only illumination device to illuminate the face of the occupant is known from sun shades, as disclosed in DE 60 2005 005 783 T2. Such illumination devices are usually not suited to illuminate the face of an occupant in such way, that a video recording provides a high-class video quality.

BRIEF SUMMARY OF THE INVENTION

[0007] Therefore, it is an object of the present invention to provide a system for illuminating the face of an occupant for a video call in a car, comprising at least one light source, and the light source should have a main light emission direction which is directed to the face of the occupant. The system comprising the at least one light source has to be qualified in such a way, that a high-class video recording within the vehicle interior is enabled.

[0008] The invention discloses the technical teaching that the system comprises a camera, and the camera is provided to record the face of the occupant, whereas the system is performed to control the light source in such a way to obtain a flickering free recording of the face of the occupant.

[0009] Artificial light sources, in particular semiconductor-light sources as LEDs or OLEDs, do not continuously emit light as it is believed by human eyes, instead they turn on and off at a certain frequency. This leads to a flickering effect in particular when a video camera is used to record the face of an occupant, which is illuminated by a semiconductor-light source. To solve this effect, the inventive system controls the light source in such a way to match the so-called frame rate of the artificial light to the frame rate of the camera. This leads to a flickering free recording of the face of the occupant. As a result, the video recording in the vehicle interior is of high quality and the occupant can take part in a video conference with other participants.

[0010] In particular, the system provides a control unit which control unit is connected to the at least one light source and provides pulsed operating to control the light source. The pulsed frequency to operate the light source is matched to the frame rate of the applied camera of the system.

[0011] The control unit is connected to the camera and the horizontal frequency of the camera is received and/or controlled by the control unit. The horizontal frequency is the result of the frame rate to operate the camera.

[0012] The control unit is performed to control the light source with a frequency which is depending on the horizontal frequency of the camera, the so called frame rate. As a result, the horizontal frequency of the camera is matched to the pulse rate of the light source.

[0013] Moreover, the system comprises at least one light sensor, which light sensor is connected to the control unit, and the light sensor is arranged to detect the light of the surrounding area. The controlling of the at least one light source and/or the setting of the camera by means of the control unit of the system can additionally or preferentially depend on the surrounding light, for example if a solar irradiation is detected at present or not, e.g., when it is cloudy, rainy or it is already dark night. This leads to totally different settings of operating the at least one light source or, in particular, more than one light source, namely two, three, four or more light sources.

[0014] Accordingly, the system can comprise at least two light sources or more than two light sources, whereas at least one light source is positioned in such a way that the main light emission direction comprises an angle to a viewing axis of the occupant, which angle α is >0. It has been found that a cove light leads to the best results for illuminating the face of an occupant, but nevertheless another light source, e. g. with a lower light intensity, can directly illuminate the face of the occupant from the direct front viewing axis. In other words, at least one light source, e.g., combined with the camera, can be positioned in a center in front of the face of the occupant and at least one or preferred two light sources can provide a cove light, a top light or a light source underneath the face to provide a full and evenly balanced illumination of occupant's face. The light sources can be operated with different power to provide a different brightness.

[0015] According to yet another embodiment, the system comprises at least one face sensor, which face sensor is connected to the control unit and the face sensor is arranged to detect the light or light distribution in the face and/or to detect the skin color of the occupant. The control unit is performed to operate the at least one light source and/or the settings of a camera depending on the measuring values of the face sensor. If the face is illuminated very bright, in particular, when the surrounding area provides another light illumination into the vehicle interior, the at least one light source can be powered down. When the face sensor detects a poor illumination of the face or a part of the face of the occupant than the at least one light source can be powered up or down with more or less light.

[0016] The at least one light source comprises a semiconductor emitter, in particular a LED or an OLED, and the light source features a color rendering index (CRI) of at least 80, preferred at least 85 and most preferred at least 90 or up to 100. In other words, the semiconductor emitter is performed to emit a high quality light with a nearly full visible spectrum of colors.

[0017] According to another advantage, the light source features a colored temperature range of 2,700 K to 5,000 K and/or the intensity range amounts 10 lm to 900 lm.

[0018] Moreover, the system comprises a display which is provided in front of the occupant, whereas the display is connected to the control unit. In particular, the brightness of the display can be controlled by the control unit depending on the operating mode of the light source and/or depending on the irradiated light of the surrounding area. The display can also form one of the light sources and can be adjusted in the brightness or in the color as needed to obtain the desired color in the face of the occupant.

[0019] The objective of the invention is also solved by a method to operate a system according to the description above, whereas the at least one light source is operated depending on at least one further information at least comprising the light of the surrounding area, received by the light sensor.

[0020] The method according to the invention is performed to operate the at least one light source depending on the skin color of the face of the occupant received by the face sensor.

[0021] The at least one light source can be operated additionally depending on the content of the occupant's video call which is received by the camera and displayed by the display. This means that the control unit is programmed in such a way that the look and appearance of the occupant's face can be different for a private video call, e. g. with family, or for a business video call, e.g., with the firm, with a customer or the like. For example, a private video call needs a warm, well colored face of the occupant, and the in a business video the appearance of the face of the occupant can be more strict or having a more authoritarian look, e.g. with less warm colors.

[0022] It is also thinkable that the system comprises a microphone and when the occupant talks very strong and hard, the illumination of the face is colored more authoritarian, and when the system receives a more silent voice from the occupant with a warm mood of the occupant, the illumination of the face can be warmer.

[0023] According to yet another advantage, the at least one light source is operated depending on the content of the occupant's video call which is received by the camera and displayed by the display. The display is advantageously performed as a touch-display, and the occupant can choose between different settings how the illumination of his face should be performed. In other words, the system provides the automatic adjustment of the illumination of the face or the system provides the possibility to choose a preferred illumination or illumination mood the occupant wants to have for his face.

[0024] According to yet another advantage, at least one reference skin color of the face of the occupant is implemented into the control unit, and the at least one light source is operated in such a way that the reference skin color of the face of the occupant is depending on the content of the occupant's video call.

[0025] Finally, the reference skin color can depend on the content of the video call and the control unit is performed to select the reference skin color depending on the content of the video call. Subsequently, the actual illumination of the face is performed depending on what reference color has been selected.

[0026] The aforementioned embodiments, as well as the claimed components of the system and the method to be used in accordance with the invention in the described embodiments, are not subject to any special exceptions with respect to their size, shape, material selection and technical concept such that the selection criteria known in the pertinent field can be applied without limitations.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] Reference is now made more particularly to the drawings, which illustrate the best presently known mode of carrying out the invention and wherein similar reference characters indicate the same parts throughout the views.

[0028] FIG. **1** is a schematical side view of a car and an occupant with a system applied in the car according to the present invention.

[0029] FIG. **2** is a schematic view of the system with the components to be used in a car.

[0030] FIG. **3** illustrates a first embodiment of the positioning the light sources.

[0031] FIG. **4** illustrates a second embodiment of positioning the light sources.

[0032] FIG. **5** illustrates a third embodiment of positioning the light sources of the system.

[0033] FIG. **6** illustrates a display of the system containing the at least one light source.

DETAILED DESCRIPTION OF THE INVENTION

[0034] FIG. **1** shows a side view of a car **2** comprising a system **100** according to the present invention. The system **100** is performed for illuminating the face of an occupant **1** sitting on the back seat of the car **2**. The system **100** comprises several light sources **3**, which emit light with a main light emission direction A onto the face **4** of the occupant **1**.

[0035] The system **100** comprises a camera **5**, and the camera **5** is provided to record the face **4** of the occupant **1**, whereas the embodiment shows the camera **5** on top of the head rest **13** of the front seat. Additionally, to the head rest **13** the display **9** is attached, so that the occupant **1** can view onto the display **9** in a convenient manner and the face **4** can be recorded by the camera **5** from a convenient position.

[0036] A first light source **3** is arranged directly under the roof of the car **2**, and another light source **3** is arranged in the lower area of the front seat of the car **2**. Both light sources **3** are adjusted so that the main light emission direction A is directed to the face **4** of the occupant **1**.

[0037] The system also comprises a face sensor **8** for measuring the skin color of the occupant's face **4**, and the system **100** comprises a light sensor **7** for detecting the circumference or ambient light conditions.

[0038] As a core the system **100** a control unit **6** is provided, which is depicted in the dash board **10** of the car **2** together with the steering wheel **11**.

[0039] FIG. **2** shows the system **100** with the several elements in a schematic view but without the car **2** according to FIG. **1**.

[0040] The head of the occupant **1** is shown with his face **4**, and the main viewing axis V is shown in a horizontally manner. The first light source **3** is placed above the face **4** and the second light source **3** is placed in a lower position. The camera **5** is arranged on top of the display **9** and the display **9** is arranged in front of the face **4** of the occupant **1** and the viewing axis V forms a surface normal to the surface of the display **9**. The face sensor **8** is provided to measure the color of and/or the brightness in the face **4**, and the light sensor **7** is performed to measure the ambient light.

[0041] The upper light source **3** is arranged under an angle α to the viewing axis V of the occupant **1**, which leads to a cove light, which is resulting in the best illumination of the face **4**.

[0042] The components as named above are controlled by the control unit **6**, which also can be part of the display **9**. As another embodiment, the display **9** combined with the control unit **6**, camera **5** and/or the face sensor **8** can be a smart phone or a tablet PC, which is attached in an appropriate position inside the car.

[0043] The at least one light source **3** or several light sources **3** are arranged in the car at different positions, whereas according to another embodiment the light source **3** can be performed by the display **9**. The display **9** also can illuminate the face **4** of the occupant **1**, and in or behind the display **9** another light source **3** can be arranged.

[0044] FIG. **3** shows a first embodiment of arranging light sources **3** as cove lights, forming an angle α to viewing axis V related to the main light emission direction A. The light sources **3** illuminate the face **4** of the occupant **1**, sitting on the driver's seat and holding the steering wheel **11** in front of the dashboard **10**. The embodiment shows the accommodation of the camera **5** and display **9** in or in conjunction with the dashboard **10**.

[0045] FIG. **4** shows a light source **3** directly in front of the face **4** of the occupant **1**, and the light source **3** is arranged in the dashboard **10**. In front of the light source **3** the camera **5** and/or the display **9** is arranged.

[0046] FIG. **5** shows a dashboard **10** with a head-up display **12**, and the light source **3** can be part of the head-up display **12** to illuminate the face **4** of the occupant **1**, when the light is reflected in the front screen **14** of the car.

[0047] Finally, FIG. **6** shows a display **9** containing two light sources **3**, which are formed by the display **9** itself or which are arranged in front of the display **9**, in the side area or behind the display **9**. When the occupant **1** views the display **9** the face of the occupant is illuminated by the light sources **3**. The light source **3** can be integrated in the display **9** and can be formed by means of the surface emitter as a part of the LCD display, the light source **3** is then preferred an OLED surface emitter.

[0048] The present invention is not limited by the embodiments described above, which are represented as examples only and can be modified in various ways within the scope of protection defined by the appending patent claims.

LIST OF NUMERALS

[0049] **1** occupant
[0050] **2** car
[0051] **3** light source
[0052] **4** face
[0053] **5** camera
[0054] **6** control unit
[0055] **7** light sensor
[0056] **8** face sensor
[0057] **9** display
[0058] **10** dashboard
[0059] **11** steering wheel
[0060] **12** head up display
[0061] **13** head rest
[0062] **14** front screen
[0063] **100** system
[0064] α angle
[0065] A main light emission direction
[0066] V viewing axis

We claim:

1. A system for illuminating a face of an occupant for a video call in a car, the system comprising:
- at least one light source having a main light emission direction (A) which is directed toward the face (**4**) of the occupant (**1**);
- a camera provided to record the face of the occupant,
- wherein the light source is controlled to obtain a flickering free recording of the face of the occupant.

2. The system according to claim **1**, further including a control unit connected to the at least one light source and provides pulsed operating to control the light source.

3. The system according to claim **2**, wherein the control unit is connected to the camera, and a horizontal frequency (HF) of the camera is received and/or controlled by the control unit.

4. The system according to claim **3**, wherein the control unit controls the light source depending on the horizontal frequency (HF) of the camera.

5. The system according to claim **1**, wherein at least one light sensor is provided, which at least one light sensor is connected to the control unit, and the at least one light sensor is arranged to detect light of a surrounding area.

6. The system according to claim **1**, wherein at least two light sources are provided, wherein at least one light source of said at least two light sources is positioned such that the main light emission direction (A) comprises an angle (α) to a viewing axis (V) off the occupant.

7. The system according to claim **2**, further including at least one face sensor connected to the control unit, wherein the face sensor detects light in and/or the skin color of the face of the occupant.

8. The system according to claim **1**, wherein the light source comprises a semiconductor emitter, and the light source features a Color Rendering Index of at least 80.

9. The system according to claim **1**, wherein the light source has a color temperature range of 2700K to 5000K and/or intensity range amounts of 10 lm to 900 lm.

10. The system according to claim **2**, further including a display positioned in front of the occupant, wherein the display is connected to the control unit.

11. A method to operate a system according to claim **5**, wherein the at least one light source is operated depending on at least one further information at least comprising light of the surrounding area received by the light sensor.

12. The method according to claim **11**, wherein the at least one light source is operated depending on a skin color of the face of the occupant, received by a face sensor connected to the control unit, wherein the face sensor detects light in and/or the skin color of the face of the occupant.

13. The method according to claim **11**, wherein the at least one light source is operated depending on a content of a video call of the occupant which is received by the camera and displayed by a display connected to the control unit.

14. The method according to claim **12**, wherein at least one reference skin color of the face of the occupant is implemented into the control unit, and the at least one light source is operated such that the reference skin color of the face of the occupant depends on a content of a video call of the occupant.

15. The method according to claim **14**, wherein the reference skin color depends on the content of the video call, and the control unit selects the reference skin color based on the content of the video call.

* * * * *