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(54) Method and intensity adjustment system for intensity adjustment of a vehicle display

(57) The present disclosure relates to a method performed by an intensity adjustment system (12) for temporarily providing intensity adjustment of a display (14) of a vehicle (10) for which display backlighting intensity has been set to a reduced backlighting intensity level (33), and which display displays at least one low priority element (31,32) constituted by display pixels and associated with low priority information. The intensity adjustment system determines (402) that at least one high priority element (37) associated with high priority information is due to be displayed on said display; temporarily increases (406) the display backlighting intensity; temporarily reduces (408) an intensity of a color components setting of at least one of the display pixels constituting the at least one low priority element, such that for the at least one of the display pixels, an aggregated intensity level based on the display backlighting intensity added to the intensity of the color components setting, remains unchanged. Furthermore, the intensity adjustment system displays (410) the high priority element, whereby the at least one high priority element temporarily appears brighter than the at least one low priority element.

Thereby, visual comfort and high visual quality may be maintained, in that - while the display backlighting intensity is temporarily increased - the high priority element(s) is temporarily displayed with relatively high brightness compared to the low priority element(s).

The disclosure also relates to an intensity adjustment system in accordance with the foregoing, as well as a vehicle comprising such an intensity adjustment system.

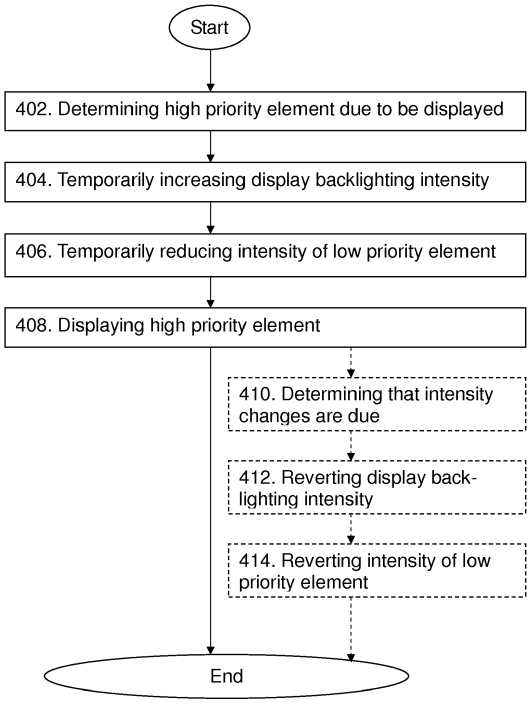

Fig. 4

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to an intensity adjustment system and a method performed therein for temporarily providing intensity adjustment of a display of a vehicle.

BACKGROUND

[0002] In order to provide e.g. a driver of a vehicle with information regarding said vehicle and e.g. the surroundings thereof, vehicles of today are commonly equipped with in-vehicle information systems. Such information systems may comprise a variety of different information types to be shown to the driver, such as for instance high priority information, in the following referred to as "alerts", and information with lower priority, in the following referred to as "static information". Alerts, which relate to temporary information that needs to come to the driver's attention, may for instance relate to important messages to be regarded by the driver, such as upcoming danger on the road, service action or route guidance instructions, or tell-tales or pop-up messages for showing malfunction of e.g. brakes or engine. Static information on the other hand, which relate to information that is non-urgent and not intended to require an action from the driver, may for instance relate to vehicle speed, meters for fuel, engine speed and temperature, as well as text and symbols reflecting status of specific systems. Static information is commonly shown permanently, and the brightness with which it is shown is thus preferably adequate for both readability and visual comfort. Alerts, on the other hand, commonly have higher requirements on visibility and the ability to grab the driver's attention, but less on the visual comfort since the alerts are not permanently shown.

[0003] Traditionally, alerts and static information have been provided separated; both spatially and illumination wise. Alerts have commonly had their individual position in e.g. the instrument cluster, and their own, adjustable lighting circuitry. Therefore, it has been possible to have one setting of lighting intensity for static information and a separate setting for alerts, implying the possibility to allow the alerts to be set much brighter than static information.

[0004] For vehicles of today, however, information is commonly combined onto one or several information displays, such as a full graphic LCD display, on which both static information and alerts may be outputted side by side. JP 1999120491, for instance, discloses an integrated vehicle information display, in which brightness control is performed so that selected information is displayed with relatively high brightness as compared to other information displayed. That is, the display provides a variety of information, for which different priority is given. If new information is received, it will be judged whether that information is emergency information, i.e. information temporarily demanding a caution from the driver. If so judged, the brightness of information with a low priority is lowered. Then, the emergency information is displayed on the display with relatively high brightness as compared to other information. Thereby, a variety of information may be displayed simultaneously, and since the essential information - i.e. the emergency information - is made conspicuous from other information, it may quickly be recognized by the driver.

[0005] Although the information display of JP 1999120491 enables the driver to distinguish high priority information from low priority information by means of the former having higher intensity than the latter, JP 1999120491 does not seem to relate to difficulties arising during e.g. night time conditions. That is, when low priority information, i.e. static information, and high priority information, i.e. alerts, share the same display, they also share the same display backlighting, for instance provided by a light source illuminating the display from behind. Backlighting can normally not be different for different areas of the display, and as a consequence, the backlighting level is commonly a compromise between the static information and the alerts. In order to maintain visual comfort with regards to the static information when the display backlighting is reduced, for instance during night time conditions, the display backlighting is accordingly commonly set lower than what would be ideal for an alert. A consequence of this may be that an upcoming alert is not as attention-grabbing or readable as it ought to be.

SUMMARY OF THE INVENTION

[0006] It is therefore an object of embodiments herein to provide, provided the display backlighting intensity of a display has been set to a reduced level, an improved way of enabling elements with high priority to temporarily appear brighter than elements with low priority, while maintaining high visual quality and comfort.

[0007] According to a first aspect of embodiments herein, the object is achieved by a method performed by an intensity adjustment system for temporarily providing intensity adjustment of a display of a vehicle for which display backlighting intensity has been set to a reduced backlighting intensity level. The display displays at least one low priority element constituted by display pixels and associated with low priority information. The intensity adjustment system determines that at least one high priority element associated with high priority information is due to be displayed on the display. The intensity adjustment system temporarily increases the display backlighting intensity. Furthermore, the intensity adjustment system temporarily reduces an intensity of a color components setting of at least one of the display pixels constituting the at least one low priority element. The reduction is such that for the at least one of the display pixels, an aggregated intensity level based on the display backlighting intensity added to the intensity of the color compo-

nents setting, remains unchanged. Additionally, the intensity adjustment system displays the high priority element, whereby the at least one high priority element temporarily appears brighter than the at least one low priority element. Thereby, since intensity of display pixels of the low priority element is temporarily reduced and the display backlighting intensity is temporarily increased while an aggregated intensity of the low priority element(s) is maintained, visual comfort for a potential user of the vehicle may subsequently likewise be maintained. Furthermore, since the display backlighting intensity is temporarily increased while the high priority element(s) is displayed, and thus without needing to increase an intensity of a color components setting of at least one of display pixels constituting the at least one high priority element, the high priority element(s) may temporarily be displayed with relatively high intensity. Accordingly, the relatively high intensity, and thus the relatively high perceived brightness, may easily bring the attention of said user to the high priority element(s). Furthermore, since intensity of display pixels of the low priority element is temporarily reduced while intensity of display pixels of the high priority may remain unchanged, the high priority element(s) is temporarily displayed with higher intensity than the low priority element(s). Thereby, high visual quality may be maintained in that information considered to be of great importance may catch the attention of the user to greater extent than information considered to be of less importance. For that reason, provided the display backlighting intensity of a display has been set to a reduced level, enablement of elements with high priority to temporarily appear brighter than elements with low priority, while maintaining high visual quality and comfort, has been improved.

[0008] In other words, since the introduced concept is based on the relationship between display backlighting intensity and transmittance of display pixels, an increase of display backlighting intensity may be compensated by a lower transmittance of display pixels, which combined may result in an essentially unchanged pixel intensity viewed by an observer. Accordingly, by temporarily increasing the display backlighting while setting display pixels constituting the low priority element(s) darker (lower transmittance), the result is an essentially unchanged viewed intensity of the low priority element(s) while the high priority element(s) appear highlighted.

[0009] The technical features and corresponding advantages of the above mentioned method will be discussed in further detail in the following.

[0010] By introducing a method performed by an intensity adjustment system for temporarily providing intensity adjustment of a display of a vehicle for which display backlighting intensity has been set to a reduced backlighting intensity level, a solution applicable during e.g. night time driving is provided. A reduced display backlighting intensity may be appropriate for instance during twilight and/or night time conditions, that is when ambient light may be relatively dark. With reduction of the display backlighting intensity, visual comfort may be maintained in that the display appears less bright, thus enabling for a potential user of the vehicle to better concentrate on the road and/or traffic. A relatively dark for instance display background, e.g. essentially black, may be less likely perceived as disturbing by the user. Said user is throughout this disclosure, for the sake of simplicity, referred to as the "driver" (of the vehicle), although the user likewise may refer to for instance a passenger of the vehicle or even a bystander. The display backlighting intensity may have been set to the reduced backlighting intensity level as known from prior art, for instance manually by e.g. said driver, and/or automatically by taking into account ambient light which for instance may be retrieved from one or several light sensors. By stating that the display is a display "of a vehicle", it is suggested that the display is intended to - by said driver - be glanced at occasionally, briefly and/or out of a corner of an eye, rather than continuously stared at. The display is provided within the vehicle, for instance mounted thereto, or comprised in a portable electronic device carried on-board the vehicle, such as a mobile phone, a computer such as e.g. a laptop, a Personal Digital Assistant (PDA) or tablet computer, sometimes referred to as a surf plate, or an iPad. "Display" is throughout this disclosure intended to be interpreted in a broad manner, likewise including at least "screen". In some sense, the display need not necessarily be a digital display, but may even be represented by any suitable surface functioning as a display for projection, e.g. a windscreen, or a head-up display. Furthermore, the display may be an LCD, for instance a transmissive TFT LCD (thin film transistor liquid crystal display) display unit which may include for instance a TFT LCD glass panel as well as a backlighting source such as one or a combination of a CCFL (cold cathode fluorescent lamp), LED(s) (light emitting diodes) and incandescent bulb(s). Additionally, the referred to vehicle may be any arbitrary vehicle, for instance an engine-propelled vehicle, such as e.g. a car, truck, lorry, van, bus, tractor, military vehicle, scooter, motorcycle, air plane, vessel such as e.g. a ship, and/or golf cart, or alternatively a rail-bound vehicle, such as e.g. a train or tram.

[0011] By the display displaying at least one low priority element constituted by display pixels and associated with low priority information, the display shows content considered being of relative low importance. The low priority element(s) is throughout this disclosure intended to be interpreted to refer to display pixels of the display which are not considered to constitute the high priority element(s). Accordingly, the low priority element(s) may thus comprise virtually displayed content ranging from for instance plain display background to content of relative low importance associated with e.g. information systems of the vehicle.

[0012] By the intensity adjustment system determining that at least one high priority element associated with high priority information is due to be displayed on the display, it is implied that the display is about to show

content considered being of relative high importance. The high priority element(s) is throughout this disclosure intended to be interpreted to at least include virtually displayed information such as important messages intended to be regarded by the driver.

[0013] By the intensity adjustment system temporarily increasing the display backlighting intensity, the possibility of displaying display content with increased intensity is enabled. Thereby, the attention of the potential driver may more easily be drawn thereto. The higher the display backlighting intensity, the higher may the intensity of the displayed content be. Furthermore, since display backlighting intensity only is increased temporarily rather than permanently, disadvantages related to high display backlighting intensity may subsequently only appear temporarily instead of permanently. Accordingly, display bleed-through as a result of high display backlighting intensity, and hence sections of the display intended to appear e. g. black to rather be perceived greyish, may be limited to a relatively short period of time rather than being permanently present. Increasing the display backlighting intensity may be performed essentially instantaneously or performed gradually, for instance in a plurality of steps, in a manner of fading. Furthermore, increasing the display backlighting intensity may for instance comprise increasing the display backlighting intensity to a relatively high backlighting intensity level, for instance to a maximum backlighting intensity level. "Maximum" is throughout this disclosure intended to be interpreted to likewise refer to "essentially maximum" and/or "close to maximum". Additionally and/or alternatively, increasing the display backlighting intensity may for instance comprise increasing the display backlighting intensity level to more than 50%, preferably more than 70% and most preferred more than 90% of a maximum backlighting intensity level.

[0014] By the intensity adjustment system furthermore temporarily reducing an intensity of a color components setting of at least one of the display pixels constituting the at least one low priority element, the at least one of the display pixels is made less transmissive. Thereby, increased brightness of the low priority element as a result of the increased display backlighting intensity is avoided. Furthermore, since intensity of the color components setting of the at least one of the display pixels constituting the at least one low priority element only is reduced temporarily rather than permanently, disadvantages related to said reduction may subsequently only appear temporarily instead of permanently. Accordingly, the reduced number of colors/hues and e.g. grey tones due to the reduction in dynamic range of a display pixel of the low priority element(s), may be limited to a relatively short period of time rather than being permanently reduced. The display pixels may be referred to as small individual elements holding quantized values that represent the brightness of a given color at any specific point. Furthermore, reducing the intensity of the color components setting of said at least one of the display pixels constituting the at least one low priority element may be performed essentially instantaneously or performed gradually, for instance in a plurality of steps, in a manner of fading. Additionally, the reduction of intensity of the color components setting may be achieved by reducing the color intensity of each respective color component representing the pixel content mixture, e.g. the primary colors red, green and blue of an RGB color model. That is, each display pixel in the e.g. LCD display may comprise liquid crystals, which optical transmittance, i.e. the fraction of light from the backlighting source which the display pixel lets through, is related to the strength of the electrical field potentially applied to it. Accordingly, the display pixels may appear darker or brighter depending on the applied electrical field, when placed in front of a display backlighting source. The higher the transmittance, the lighter is the pixel observed by the driver. The number of steps between fully transparent and fully dark may for instance be represented by 256 levels for each of the RGB colors red, green and blue, which combined may reproduce over 16 million colors. Furthermore, the color intensities of the respective color components, which each may have an arbitrary intensity from e.g. 0-100%, may be equally reduced. According to one example, for instance white color may be reduced from an RGB value of 255, 255, 255 to 64, 64, 64, which may represent a reduction by 75% of perceived brightness. Additionally, the intensity of the color components setting may preferably be reduced for the majority of - or even all of - the display pixels constituting the low priority element(s).

[0015] By the reduction of the intensity of the color components setting being such that for the at least one of the display pixels constituting the at least one low priority element, an aggregated intensity level based on the display backlighting intensity added to the intensity of the color components setting, remains unchanged, intensity of the low priority element remains at a constant level. That is, by reducing the intensity of the low priority element(s) while increasing the display backlighting intensity, subsequently the brightness of the low priority element(s) may remain unchanged. Thereby, although the display backlighting now has been increased, the low priority element(s) does not appear brighter. Accordingly, the potential driver may not necessarily even notice that the display backlighting intensity has changed. "Based on" is throughout this disclosure intended to be interpreted to likewise include at least "utilizing", "considering" and "taking into account". Additionally, "aggregated intensity level" is here intended to refer to a total intensity of a display pixel, i.e. a summarized intensity, which takes into account the display backlighting intensity and the intensity of the color components setting of the display pixel. Furthermore, the aggregated intensity level remaining "unchanged" is throughout this disclosure intended to likewise refer to "essentially unchanged" and/or "close to unchanged", thus covering minor fluctuations and/or deviations. Although fluctuations as small as possible are preferred, deviations may range up to e.g. 25%.

It should furthermore be noted that according to one example, when referring to the aggregated intensity level remaining unchanged, rather an aggregated intensity, e. g. brightness, as perceived by the driver, remains unchanged.

[0016] By the intensity adjustment system additionally displaying the high priority element, whereby the at least one high priority element temporarily appears brighter than the at least one low priority element, information considered to be of high importance may in a user friendly manner be shown simultaneously with information considered to be of lower importance. That is, since the aggregated intensity level remaining unchanged does not refer to the high priority element(s), i.e. color components settings of display pixels of the high priority element(s) is not affected by said decreased intensities, the increased display backlighting intensity enables the high priority element(s) to be displayed with higher intensity as compared to the low priority element(s). Thereby, the high priority element(s) may appear brighter than the lower priority element(s), thus drawing the attention of the potential driver primarily to the information considered to be of high importance rather than the information considered to be of low importance.

[0017] Since the above discussed actions of increasing the display backlighting intensity and reducing the intensity of the color components setting of the at least one of the display pixels constituting the at least one low priority element, are temporary, when the display backlighting intensity no longer is increased, brightness of the high priority element(s) is subsequently reduced. "Temporarily" is throughout this disclosure intended to be interpreted to at least refer to a period of time considered to be relatively short, such as for instance a period of time considered to be adequate to ensure catching the driver's attention. Such a period of time may for instance range from merely parts of a second up to several minutes or even hours or days, after which said increased and decreased intensities may be reverted.

[0018] The above discussed method may be continuously repeated, for instance during a predetermined period of time or a predetermined number of times, such that said high priority element(s) may appear to be pulsating, in order to catch the potential driver's attention to an even greater extent. The frequency by which such a pulsation may be performed, may range for instance from several times per second to once every few seconds, minutes, hours or days, or based on for instance travel distance of the vehicle or an event associated with the vehicle such as starting the engine, buckle-up, filling up fuel etc.

[0019] Furthermore, said actions of determining, increasing and reducing may for instance be performed by means of a control unit comprised in one or several suitable electronic devices, such as a display backlighting controller and graphical controller, and/or e.g. one or several integrated arbitrary electronic control unit (ECU) nodes such as e.g. a cluster node, display controller node or main central node, either on-board the vehicle or remotely arranged.

[0020] It should be noted, that due to the reduced intensity of the color components setting of the at least one of the display pixels constituting the at least one low priority element, although the aggregated intensity thereof is unchanged, an effect may be that color depth of the corresponding display pixel may be decreased. That is, the number of colors/hues and grey tones of said display pixel(s) may become limited due to the limitation in dynamic range. Furthermore, due to the increased display backlighting intensity, display bleed-through may be revealed, i.e. higher light leakage, for instance sections of the display that were supposed to be black may be perceived grey. However, as previously mentioned, since the discussed actions of increasing the display backlighting intensity and reducing the intensity of the color components setting of the at least one of the display pixels constituting the at least one low priority element, are temporary, said reduced dynamic range and/or said bleed-through are not even necessarily noticed by the potential driver; his/or her attention is presumably rather focused on the high priority element(s) during this fairly short period of time.

[0021] According to an embodiment, the low priority element may comprise content considered to be static, non-urgent and/or not intended to require an action from a potential user of the vehicle, such as for instance one or a combination of display background; arbitrary status text and symbols; meters, gauges, scales, or guiding frames associated with e.g. vehicle speed, fuel, engine speed and temperature; and navigation map. According to another embodiment, the high priority element may comprise content regarded as at least one alert intended to catch the user's attention and/or intended to potentially require an action from the user, such as for instance a pop-up message for showing malfunction in a system of the vehicle; e.g. brakes or engine; an important message, e.g. upcoming danger on the road ahead such as a queue, sharp curve, or slippery road; a service action, e. g. washer fluid low; and/or a route guidance instruction.

[0022] According to one embodiment, the action of reducing the intensity of the color components setting of the at least one of the display pixels and the action of increasing the display backlighting intensity are performed simultaneously. Thereby, the aggregated intensity level of a display pixel may remain unchanged as the display backlighting intensity while increasing, e.g. gradually, interplays with the intensity of the color components setting being correspondingly reduced. "Simultaneously" is throughout this disclosure intended to be interpreted to likewise refer to "essentially simultaneously" and/or "close to simultaneously".

[0023] According to another embodiment, the action of increasing the display backlighting intensity may comprise increasing the display backlighting intensity by an amount. Furthermore, the action of reducing the intensity of the color components setting of the at least one of the

display pixels may comprise reducing the intensity by the amount, or a calibrated value of the amount. Thereby, the intensity of the color components setting may be reduced by the same amount, or an adjusted value of the amount, as the amount with which the display backlighting intensity is increased. The referred to amount may for instance be based on a percentage of intensity, or an absolute value. The calibrated value may for instance be retrieved from a predetermined calibration table stored e.g. in a memory provided in an arbitrary e.g. electronic control unit (ECU), or adjusted in real-time based on an applicable algorithm compensating for discrepancies of actual and/or perceived unchanged aggregated intensity level.

[0024] According to yet another embodiment, the action of increasing the display backlighting intensity may comprise increasing the display backlighting intensity by means of a light source providing display backlighting to the display. Thereby, changes to the intensity of the display backlighting may be accomplished by means of a commonly utilized light source known in the art, thus enabling for the intensity adjustment system to be implemented in an efficient and cost effective manner. It should be noted that the light source, rather than referring to a single light source, may be represented by a plurality thereof. According to an example, the backlighting intensity may further be controlled by means of a backlighting controller, commonly known in the art, thus further enabling for the intensity adjustment system to be implemented in an efficient and cost effective manner.

[0025] According to one embodiment, the action of reducing the intensity of the color components setting of the at least one of the display pixels may comprise reducing the intensity by means of a graphical controller providing pixel content to the display. Thereby, changes to the intensity of the color components setting of the at least one display pixel may be accomplished by means of a commonly utilized graphical controller known in the art, thus enabling for the intensity adjustment system to be implemented in an efficient and cost effective manner. The graphical controller may be provided in any arbitrary applicable e.g. ECU.

[0026] According to another embodiment, the intensity adjustment system may further determine that intensity changes are due, for instance based on that a predetermined period of time has elapsed, that the high priority information has been acknowledged by the potential user of the vehicle, that a condition associated with the high priority information no longer applies, and/or that the vehicle has travelled a predetermined distance. The intensity adjustment system may further revert the display backlighting intensity, and revert the intensity of the color components setting of the at least one of the display pixels, whereby the at least one high priority element no longer appears brighter than the at least one low priority element. Accordingly, the intensities may be reverted when determined that intensity changes are due. Said period of time may be arbitrary and may be set to be long enough to assume that the high priority element(s) have caught the attention of the potential driver. The period of time may thus range for instance from merely parts of a second up to several minutes or even hours. Additionally, said acknowledgment by the potential driver may for instance refer to the driver confirming that he or she has learned of the high priority information associated with the high priority element(s), and said condition associated with the high priority information no longer applying may refer to such a condition having ceased, being solved and/or reset. Furthermore, the vehicle having travelled a predetermined distance may refer to an arbitrary vehicle travel distance, for instance ranging from a few kilometres to hundreds of miles.

[0027] According to a further embodiment, the action of reverting the intensity of the color components setting of the at least one of the display pixels constituting the at least one low priority element and the action of reverting the display backlighting intensity may be performed simultaneously. Thereby, the aggregated intensity level of a display pixel may remain unchanged as the display backlighting intensity while being reduced, e.g. gradually, interplays with the intensity of the color components setting being correspondingly increased. As previously mentioned, "simultaneously" is throughout this disclosure intended to be interpreted to likewise refer to "essentially simultaneously" and/or "close to simultaneously".

[0028] According to one embodiment, the action of increasing the display backlighting intensity may comprise increasing the display backlighting intensity from the reduced backlighting intensity level to an increased backlighting intensity level. Furthermore, the action of reducing the intensity of the color components setting of the at least one of the display pixels may comprise reducing the intensity from a current selected pixel intensity level to a reduced pixel intensity level, wherein the aggregated intensity level is based on adding the increased backlighting intensity level to the reduced pixel intensity level. Thereby, by increasing the display backlighting intensity from the reduced backlighting intensity level to an increased backlighting intensity level, and reducing the intensity of the color components setting from a current selected pixel intensity level to a reduced pixel intensity level, levels are introduced between which the intensities change. Furthermore, by the aggregated intensity level being based on adding the increased backlighting intensity level to the reduced pixel intensity level, said levels may constitute the aggregated intensity level.

[0029] In a similar manner, according to a further embodiment, the action of reverting the display backlighting intensity may comprise reducing the display backlighting intensity from the increased backlighting intensity level to the reduced backlighting intensity level. Furthermore, the action of reverting the intensity of the color components setting of the at least one of the display pixels may comprise increasing the intensity from the reduced pixel intensity level to the selected pixel intensity level. There-

by, the intensities may change between the introduced levels in a similar manner as previously discussed, although conversely.

[0030] According to one embodiment, the reduced backlighting intensity level may be less than 80%, preferably less than 50%, and most preferably less than 20% of a maximum backlighting intensity level. Thereby, the reduced backlighting intensity level may have been set to a level reduced sufficiently enough to distinguish the high priority element(s) from the low priority element(s). That is, the lower the backlighting intensity level is initially set to, the higher may the relative intensity difference between the high and the low priority elements be.

[0031] According to a second aspect of embodiments herein, the object is achieved by an intensity adjustment system for temporarily providing intensity adjustment of a display of a vehicle for which display backlighting intensity is adapted to be set to a reduced backlighting intensity level. The display is adapted to display at least one low priority element constituted by display pixels and associated with low priority information. The intensity adjustment system comprises the display. The intensity adjustment system furthermore comprises a control unit adapted for determining that at least one high priority element associated with high priority information is due to be displayed on the display. The control unit is further adapted for temporarily increasing the display backlighting intensity, and temporarily reducing an intensity of a color components setting of at least one of the display pixels constituting the at least one low priority element, such that for the at least one of the display pixels, an aggregated intensity level based on the display backlighting intensity added to the intensity of the color components setting, remains unchanged. Furthermore, the control unit is adapted for displaying the high priority element, whereby the at least one high priority element temporarily appears brighter than the at least one low priority element. According to an embodiment, the display comprises a liquid crystal display (LCD). Similar advantages as those mentioned in the foregoing correspondingly apply, why these are not further discussed.

[0032] According to a third aspect of embodiments herein, the object is achieved by a vehicle comprising the previously discussed intensity adjustment system. The display is provided in the vehicle, and preferably comprised in an instrument panel, head-up display, center stack, cluster, wind screen and/or dashboard of the vehicle. Yet again, similar advantages as those mentioned in the foregoing correspondingly apply, why these are not further discussed.

[0033] It should be understood that said method of temporarily providing intensity adjustment may require the display to be in an "ON" state.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] The various aspects of the non-limiting embodiments of the invention, including particular features and advantages, will be readily understood from the following detailed description and the accompanying drawings, in which:

Figure 1 illustrates an exemplifying vehicle comprising an intensity adjustment system for temporarily providing intensity adjustment of a display of a vehicle for which display backlighting intensity has been set to a reduced level according to embodiments of the disclosure;

Figure 2 is a schematic block diagram illustrating an intensity adjustment system according to embodiments of the disclosure;

Figure 3 shows exemplifying display views of varying intensity adjustments according to embodiments of the disclosure; and

Figure 4 is a flowchart depicting an exemplifying method performed by an intensity adjustment system for temporarily providing intensity adjustment of a display of a vehicle for which display backlighting intensity has been set to a reduced level according to embodiments of the disclosure.

DETAILED DESCRIPTION

[0035] The non-limiting embodiments of the present disclosure will now be described more fully hereinafter with reference to the accompanying drawings, in which currently preferred embodiments of the disclosure are shown. This disclosure may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Like reference characters refer to like elements throughout. Dashed lines of some boxes in the figures indicate that these units or actions are optional and not mandatory.

[0036] In the following, according to embodiments herein which relate to temporarily providing intensity adjustment of a display of a vehicle for which display backlighting intensity has been set to a reduced backlighting intensity level, there will be disclosed how elements with high priority temporarily may appear brighter than elements with low priority, while high visual quality and comfort is maintained.

[0037] Referring now to the figures and **Figure 1** in particular, there is depicted an exemplifying **vehicle 10** comprising an **intensity adjustment system 12** for temporarily providing intensity adjustment of a **display 14** of the vehicle 10 for which display backlighting intensity has been set to a reduced level according to embodiments of the disclosure. The display 14, which here comprises a liquid crystal display (LCD), is provided in the vehicle 10, and is in the shown embodiment more specifically comprised in an **instrument panel 16** thereof. According to other embodiments, the display 14 may be comprised in a head-up display, center stack, cluster, wind screen

and/or dashboard of the vehicle 10. Furthermore, the vehicle 10 of Figure 1 is a passenger car.

[0038] As further shown in **Figure 2**, which depicts a schematic block diagram illustrating an intensity adjustment system 12 according to embodiments of the disclosure, the intensity adjustment system 12 additionally comprises a **control unit 22**. Furthermore, the embodiments herein for temporarily providing intensity adjustment of the display 14 of the vehicle 10 for which display backlighting intensity has been set to a reduced backlighting intensity level may be implemented through one or more processors, such as a **processor 24**, here denoted CPU (Central Processing Unit), together with computer program code for performing the functions and actions of the embodiments herein. Said program code may also be provided as a computer program product, for instance in the form of a data carrier carrying computer program code for performing the embodiments herein when being loaded into the intensity adjustment system 12. One such carrier may be in the form of a CD ROM disc. It is however feasible with other data carriers such as a memory stick. The computer program code may furthermore be provided as pure program code on a server and downloaded to the intensity adjustment system 12, for instance in an assembly plant, workshop or at a facility of the supplier. The intensity adjustment system 12 may further comprise a **memory 26** comprising one or more memory units. The memory 26 may be arranged to be used to store e.g. information, and further to store data, configurations, schedulings, road maps and applications, to perform the methods herein when being executed in the intensity adjustment system 12. The processor 24, the memory 26, and the control unit 22 may for instance be implemented in one or several arbitrary **nodes 28,** arranged locally on-board the vehicle, remotely, or a combination thereof. Said node 28 may be an electronic control unit (ECU) or any suitable generic electronic device, and may involve one or a combination of for instance a cluster node, a display controller node and/or a main central node. Those skilled in the art will also appreciate that the control unit 22 described above may refer to a combination of analog and digital circuits, and/or one or more processors configured with software and/or firmware, e.g. stored in a memory such as the memory 26, that when executed by the one or more processors such as the processor 24 perform as will be described in more detail later on in this description. One or more of these processors, as well as the other digital hardware, may be included in a single ASIC (Application-Specific Integrated Circuitry), or several processors and various digital hardware may be distributed among several separate components, whether individually packaged or assembled into a SoC (System-on-a-Chip).

[0039] Additionally, the intensity adjustment system 12 may optionally comprise a **light source 27**, which may be represented by a plurality of light sources, which may be utilized for display backlighting and thus for changing display backlighting intensity. Furthermore, the intensity adjustment system 12 may optionally comprise a **graphical controller 29,** providing pixel content to the display 14.

[0040] **Figure 3** shows exemplifying display views of varying intensity adjustments according to embodiments of the disclosure. The display 14 is adapted to display at least one low priority element constituted by display pixels and associated with low priority information. The low priority element may comprise content considered to be static, non-urgent and/or not intended to require an action from a potential user of the vehicle 10, such as for instance one or a combination of display background; arbitrary status text and symbols; meters, gauges, scales, or guiding frames associated with e.g. vehicle speed, fuel, engine speed and temperature; and navigation map. In the shown embodiment the display 14 displays a **first low priority element 31**, here represented by essentially black display background, along with a **second low priority element 32**, here represented by vehicle speed information. According to the shown embodiment, the light source 27 illuminates the display 14, and display intensity may be varied by means of varying illumination by the light source 27.

[0041] In the shown embodiment, the display 14 is shown at four different instances of time, T1-T4. At the first time instance, T1, the display backlighting intensity level has been set to a **reduced backlighting intensity level 33,** by means of the light source 27 having been set to illuminate the display 14 at a reduced level. The reduced backlighting intensity level 33 may be less than 80%, preferably less than 50%, and most preferably less than 20% of a maximum backlighting intensity level. Furthermore, the intensity of a color components setting of at least one of the display pixels constituting at least one of the low priority elements 31,32 is set at a current **selected pixel intensity level 34.**

[0042] At the second time instance, T2, the display backlighting intensity level has been set to an **increased backlighting intensity level 35**, by means of the light source 27 having been set to illuminate the display 14 at a relatively high level, here a maximum intensity level. Furthermore, the intensity of a color components setting of the low priority elements 31,32 has been set to a **reduced pixel intensity level 36.**

[0043] At the third time instance, T3, a **high priority element 37**, here a warning message illustrated as an encircled exclamation mark, has been displayed on the display 14. Note that although the high priority element 37 here is illustrated as white, for improved effect, in reality the high priority element may comprise color settings which to even further extent may catch the attention of a potential driver, thus for instance comprising hues of red and/or orange. The intensity of a color components setting of at least one of the display pixels constituting the high priority element 37 has been set at a current **high priority element intensity level 38.** The intensity of the display 14 is remained at the increased backlighting intensity level 35, and the intensity of the color components

setting of the low priority elements is remained at the reduced pixel intensity level 36.

[0044] At the fourth time instance, T4, the display backlighting intensity level has been reverted to the reduced backlighting intensity level 33. Furthermore, the intensity of the color components setting of the low priority elements 31,32 has been reverted to the selected pixel intensity level 34. The intensity of the color components setting of the at least one of the display pixels constituting the high priority element 37 is remained at the high priority element intensity level 38.

[0045] **Figure 4** is a flowchart depicting an exemplifying method performed by an intensity adjustment system 12 for temporarily providing intensity adjustment of a display 14 of a vehicle 10 for which display backlighting intensity has been set to a reduced level according to embodiments of the disclosure. The exemplifying method, which may be continuously repeated, comprises the following actions discussed with support from Figures 1-3. The actions may be taken in any suitable order and, where suitable, in parallel. Preceding the following actions, the display backlighting intensity of the display 14 has been set to a reduced backlighting intensity level 33, and the display 14 displays at least one low priority element constituted by display pixels and associated with low priority information, here essentially black display background 31 along with vehicle speed information 32, thus reflecting the first time instance T1 of Figure 3.

Action 402

[0046] In Action 402, the intensity adjustment system 12 determines, for instance by means of the control unit 22, that at least one high priority element associated with high priority information, here the warning message illustrated as an encircled exclamation mark 37, is due to be displayed on the display 14.

[0047] The high priority element 37 may comprise content regarded as at least one alert intended to catch the user's attention and/or intended to potentially require an action from the user, such as for instance a tell-tale; a pop-up message for showing malfunction in a system of the vehicle 10, e.g. brakes or engine; an important message, e.g. upcoming danger on the road ahead such as a queue, sharp curve, or slippery road; a service action, e.g. washer fluid low; and/or a route guidance instruction.

Action 404

[0048] In Action 404, the intensity adjustment system 12 temporarily increases, for instance by means of the control unit 22, the display backlighting intensity. Increasing the display backlighting intensity may further comprise increasing the display backlighting intensity by means of the light source 27 providing display backlighting to the display 14.

Action 406

[0049] In Action 406, the intensity adjustment system 12 temporarily reduces, for instance by means of the control unit 22, an intensity of a color components setting of at least one of the display pixels constituting the at least one low priority element, here the display background 31 along with the vehicle speed information 31,32, such that for the at least one of the display pixels, an aggregated intensity level based on the display backlighting intensity added to the intensity of the color components setting, remains unchanged. Following Action 406, the display 14 shows the display view reflected by the second time instance T2 of Figure 3.

[0050] Reducing the intensity of the color components setting of the at least one of the display pixels constituting the at least one low priority element 31,32 may comprise reducing the intensity by means of the graphical controller 29 providing pixel content to the display 14.

[0051] Action 404 of increasing the display backlighting intensity may comprise increasing the display backlighting intensity from the reduced backlighting intensity level 33 to the increased backlighting intensity level 35. Furthermore, Action 406 of reducing the intensity of the color components setting of the at least one of the display pixels constituting the at least one low priority element 31,32 may comprise reducing the intensity from the current selected pixel intensity level 34 to the reduced pixel intensity level 36, whereby the aggregated intensity level may be based on adding the increased backlighting intensity level 35 to the reduced pixel intensity level 36.

[0052] Furthermore, Action 406 of reducing the intensity of the color components setting of the at least one of the display pixels constituting the at least one low priority element 31,32 and Action 404 of increasing the display backlighting intensity may be performed simultaneously.

[0053] Additionally, Action 404 of increasing the display backlighting intensity may comprise increasing the display backlighting intensity by an amount, and Action 406 of reducing the intensity of the color components setting of the at least one of the display pixels constituting the at least one low priority element 31,32 may comprise reducing the intensity by said amount, or a calibrated value of said amount.

Action 408

[0054] In Action 408, the intensity adjustment system 12 displays the high priority element, here the warning message illustrated as an encircled exclamation mark 37, whereby the at least one high priority element 37 temporarily appears brighter than the at least one low priority element, here the display background 31 along with the vehicle speed information 31,32.

[0055] Following Action 408, the display 14 shows the display view reflected by the third time instance T3 of Figure 3.

Action 410

[0056] In optional Action 410, the intensity adjustment system 12 may determine that intensity changes are due, for instance based on that a predetermined period of time has elapsed, that the high priority information has been acknowledged by the potential user of the vehicle 10, that a condition associated with the high priority information no longer applies, and/or that the vehicle 10 has travelled a predetermined distance.

Action 412

[0057] In optional Action 412, the intensity adjustment system 12 may revert the display backlighting intensity.

Action 414

[0058] In optional Action 414, the intensity adjustment system 12 may revert the intensity of the color components setting of the at least one of the display pixels constituting the at least one low priority element, here the display background 31 along with the vehicle speed information 31,32, whereby the at least one high priority element, here the warning message illustrated as an encircled exclamation mark 37, no longer appears brighter than the at least one low priority element 31,32.

[0059] Following Action 414, the display 14 shows the display view reflected by the fourth time instance T4 of Figure 3.

[0060] Action 412 and 414 may be performed simultaneously, i.e. Action 414 of reverting the intensity of the color components setting of the at least one of the display pixels constituting the at least one low priority element 31,32 and Action 412 of reverting the display backlighting intensity may be performed simultaneously.

[0061] Action 412 of reverting the display backlighting intensity may comprise reducing the display backlighting intensity from the increased backlighting intensity level 35 to the reduced backlighting intensity level 33. Furthermore, Action 414 of reverting the intensity of the color components setting of the at least one of the display pixels constituting the at least one low priority element 31,32 may comprise increasing the intensity from the reduced pixel intensity level 36 to the selected pixel intensity level 34.

[0062] Consequently, the provision of the intensity adjustment system 12 for temporarily providing intensity adjustment of the display 14 of the vehicle 10 for which display backlighting intensity has been set to a reduced backlighting intensity level as described in the foregoing, thus enables for maintained visual comfort and high visual quality, in that - while the display backlighting intensity is temporarily increased - the high priority element(s) 37 is temporarily displayed with relatively high brightness compared to the low priority element(s) 31,32.

[0063] The person skilled in the art realizes that the present disclosure by no means is limited to the preferred embodiments described above. On the contrary, many modifications and variations are possible within the scope of the appended claims. It should furthermore be noted that the drawings not necessarily are to scale and the dimensions of certain features may have been exaggerated for the sake of clarity. Emphasis is instead placed upon illustrating the principle of the embodiments herein. Additionally, in the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality.

Claims

1. A method performed by an intensity adjustment system (12) for temporarily providing intensity adjustment of a display (14) of a vehicle (10) for which display backlighting intensity has been set to a reduced backlighting intensity level (33), said display (14) displaying at least one low priority element (31,32) constituted by display pixels and associated with low priority information, said method comprising:

determining (402) that at least one high priority element (37) associated with high priority information is due to be displayed on said display (14);
temporarily *increasing* (404) said display backlighting intensity;
temporarily *reducing* (406) an intensity of a color components setting of at least one of said display pixels constituting said at least one low priority element (31,32), such that for said at least one of the display pixels, an aggregated intensity level based on said display backlighting intensity added to said intensity of the color components setting, remains unchanged; and
displaying (408) said high priority element (37), whereby said at least one high priority element (37) temporarily appears brighter than said at least one low priority element (31,32).

2. The method in accordance with claim 1, wherein said low priority element (31,32) comprises content considered to be static, non-urgent and/or not intended to require an action from a potential user of said vehicle (10), such as for instance one or a combination of display background (31); arbitrary status text and symbols; meters, gauges, scales, or guiding frames associated with e.g. vehicle speed (32), fuel, engine speed and temperature; and navigation map.

3. The method in accordance with claim 1 or 2, wherein said high priority element (37) comprises content regarded as at least one alert intended to catch said user's attention and/or intended to potentially require an action from said user, such as for instance a pop-

up message for showing malfunction in a system of said vehicle, e.g. brakes or engine; an important message, e.g. upcoming danger on the road ahead such as a queue, sharp curve, or slippery road; a service action, e.g. washer fluid low; and/or a route guidance instruction.

4. The method in accordance with any one of the preceding claims, wherein said *reducing* (406) the intensity of the color components setting of the at least one of the display pixels and said *increasing* (404) the display backlighting intensity are performed simultaneously.

5. The method in accordance with any one of the preceding claims, wherein said *increasing* (404) the display backlighting intensity comprises *increasing* said display backlighting intensity by an amount, and wherein said *reducing* (406) the intensity of the color components setting of the at least one of the display pixels comprises *reducing* said intensity by said amount, or a calibrated value of said amount.

6. The method in accordance with any one of the preceding claims, wherein said *increasing* (404) the display backlighting intensity comprises *increasing* the display backlighting intensity by means of a light source (27) providing display backlighting to said display (14).

7. The method in accordance with any one of the preceding claims, wherein said *reducing* (406) the intensity of the color components setting of the at least one of the display pixels comprises *reducing* said intensity by means of a graphical controller (29) providing pixel content to said display (14).

8. The method in accordance with any one of the preceding claims, further comprising:

determining (410) that intensity changes are due, for instance based on that a predetermined period of time has elapsed, that said high priority information has been acknowledged by said potential user of said vehicle (10), that a condition associated with said high priority information no longer applies, and/or that said vehicle (10) has travelled a predetermined distance;
reverting (412) said display backlighting intensity; and
reverting (414) said intensity of the color components setting of the at least one of the display pixels, whereby said at least one high priority element (37) no longer appears brighter than said at least one low priority element (31,32).

9. The method in accordance with claim 8, wherein said *reverting* (414) the intensity of the color components setting of the at least one of the display pixels and said *reverting* (412) the display backlighting intensity are performed simultaneously.

10. The method in accordance with anyone of the preceding claims, wherein said *increasing* (404) the display backlighting intensity comprises:

increasing said display backlighting intensity from said reduced backlighting intensity level (33) to an increased backlighting intensity level (35),
and wherein said *reducing* (406) the intensity of the color components setting of the at least one of the display pixels comprises:

reducing the intensity from a current selected pixel intensity level (34) to a reduced pixel intensity level (36), said aggregated intensity level being based on adding said increased backlighting intensity level (35) to said reduced pixel intensity level (36).

11. The method in accordance with claim 8 or 9 in combination with claim 10, wherein said *reverting* (412) the display backlighting intensity comprises:

reducing said display backlighting intensity from said increased backlighting intensity level (35) to said reduced backlighting intensity level (33); and
wherein said *reverting* (414) the intensity of the color components setting of the at least one of the display pixels comprises:

increasing said intensity from said reduced pixel intensity level (36) to said selected pixel intensity level (34).

12. The method in accordance with any one of the preceding claims, wherein said reduced backlighting intensity level (33) is less than 80%, preferably less than 50%, and most preferably less than 20% of a maximum backlighting intensity level.

13. An intensity adjustment system (12) for temporarily providing intensity adjustment of a display (14) of a vehicle (10) for which display backlighting intensity is adapted to be set to a reduced backlighting intensity level (33), said display (14) being adapted to display at least one low priority element (31,32) constituted by display pixels and associated with low priority information, said intensity adjustment system (12) comprising:

said **display** (14); and
a **control unit** (22) adapted for *determining* (402) that at least one high priority element (37)

associated with high priority information is due to be displayed on said display (14); temporarily *increasing* (404) said display backlighting intensity; temporarily *reducing* (406) an intensity of a color components setting of at least one of said display pixels constituting said at least one low priority element (31,32), such that for said at least one of the display pixels, an aggregated intensity level based on said display backlighting intensity added to said intensity of the color components setting, remains unchanged; and *displaying* (408) said high priority element (37), whereby said at least one high priority element (37) temporarily appears brighter than said at least one low priority element (31,32).

14. The intensity adjustment system (12) in accordance with claim 13, wherein said display (14) comprises a liquid crystal display (LCD).

15. A vehicle (10) comprising the intensity adjustment system (12) in accordance with claim 13 or 14, wherein said display (14) is provided in said vehicle (10), and preferably comprised in an instrument panel (16), head-up display, center stack, cluster, wind screen and/or dashboard of said vehicle (10).

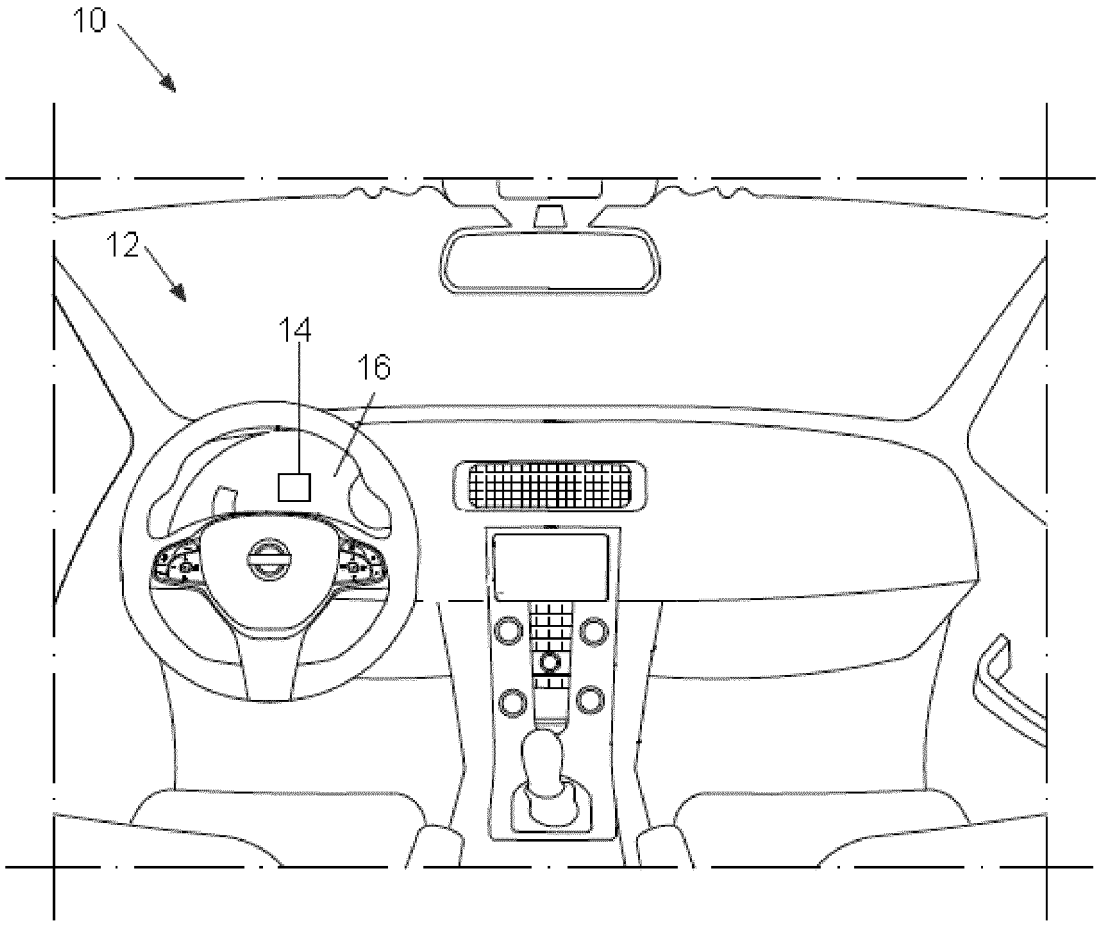

10
12
14
16

Fig. 1

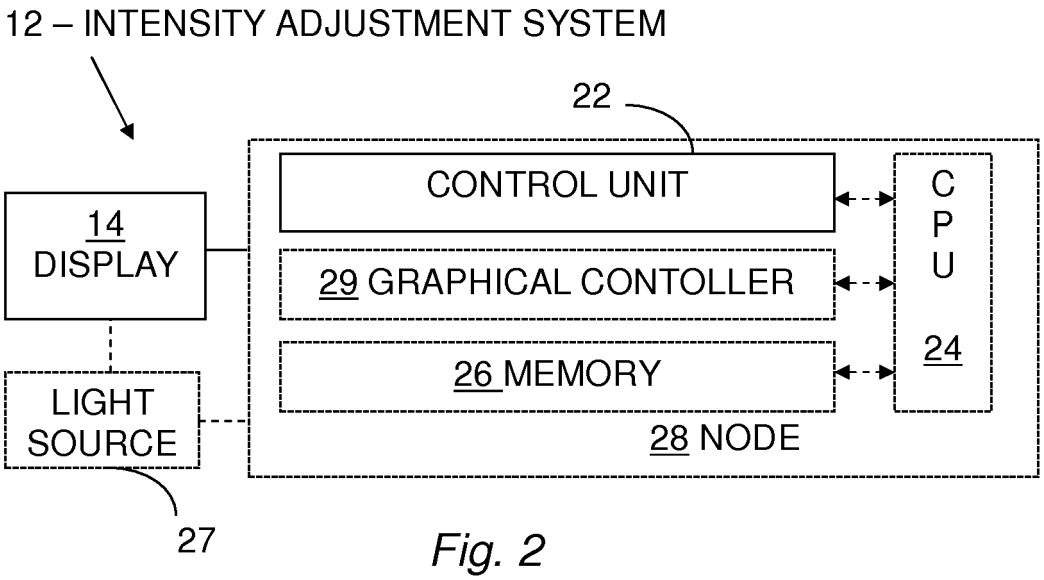
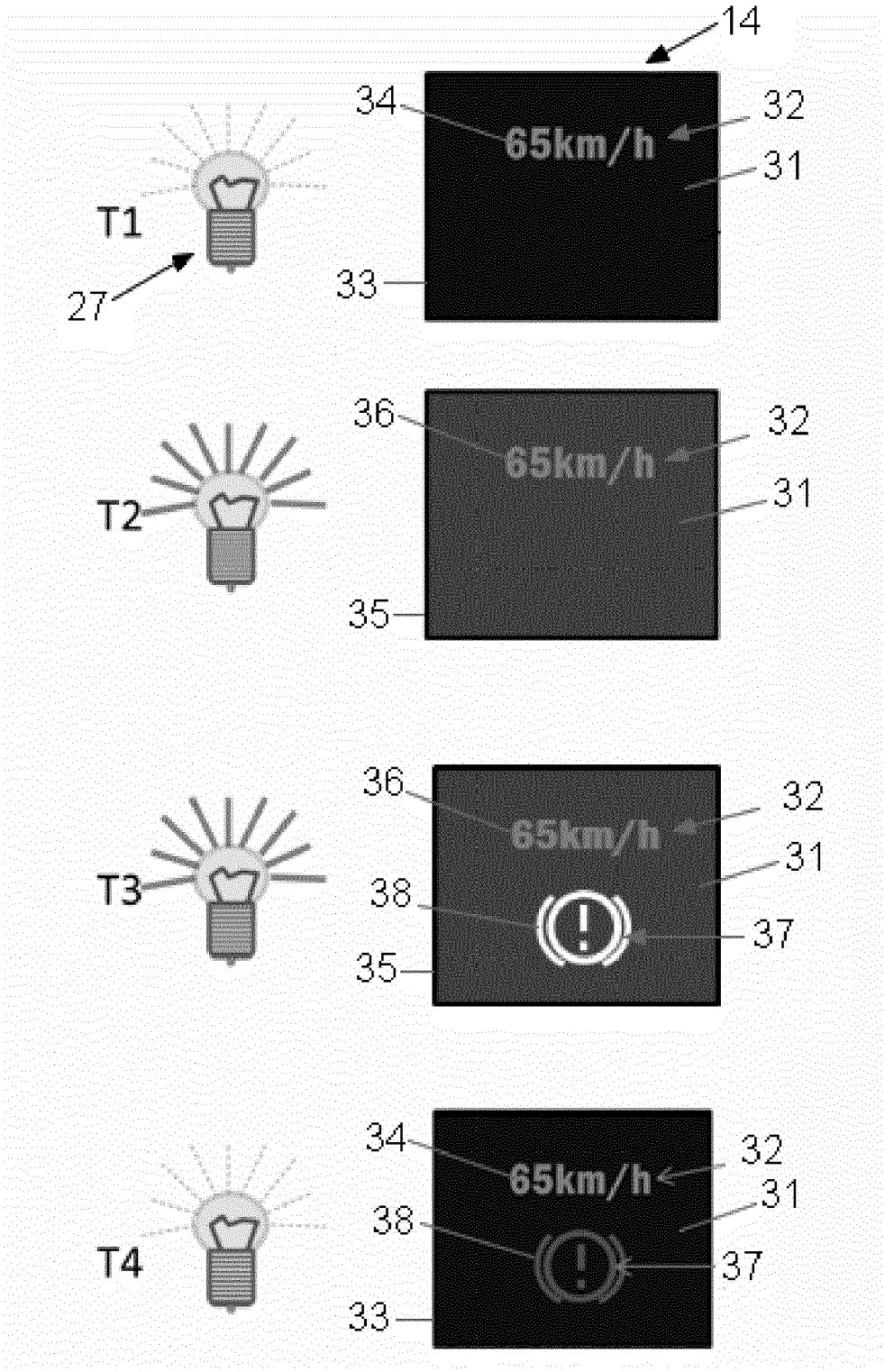

12 – INTENSITY ADJUSTMENT SYSTEM
22
CONTROL UNIT
C
P
U
24
14
DISPLAY
29 GRAPHICAL CONTOLLER
26 MEMORY
LIGHT
SOURCE
28 NODE
27

Fig. 2


14
34
65km/h
32
31
T1
27
33
36
65km/h
32
31
T2
35
36
65km/h
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T3
38
37
35
34
65km/h
32
31
T4
38
37
33

Fig. 3

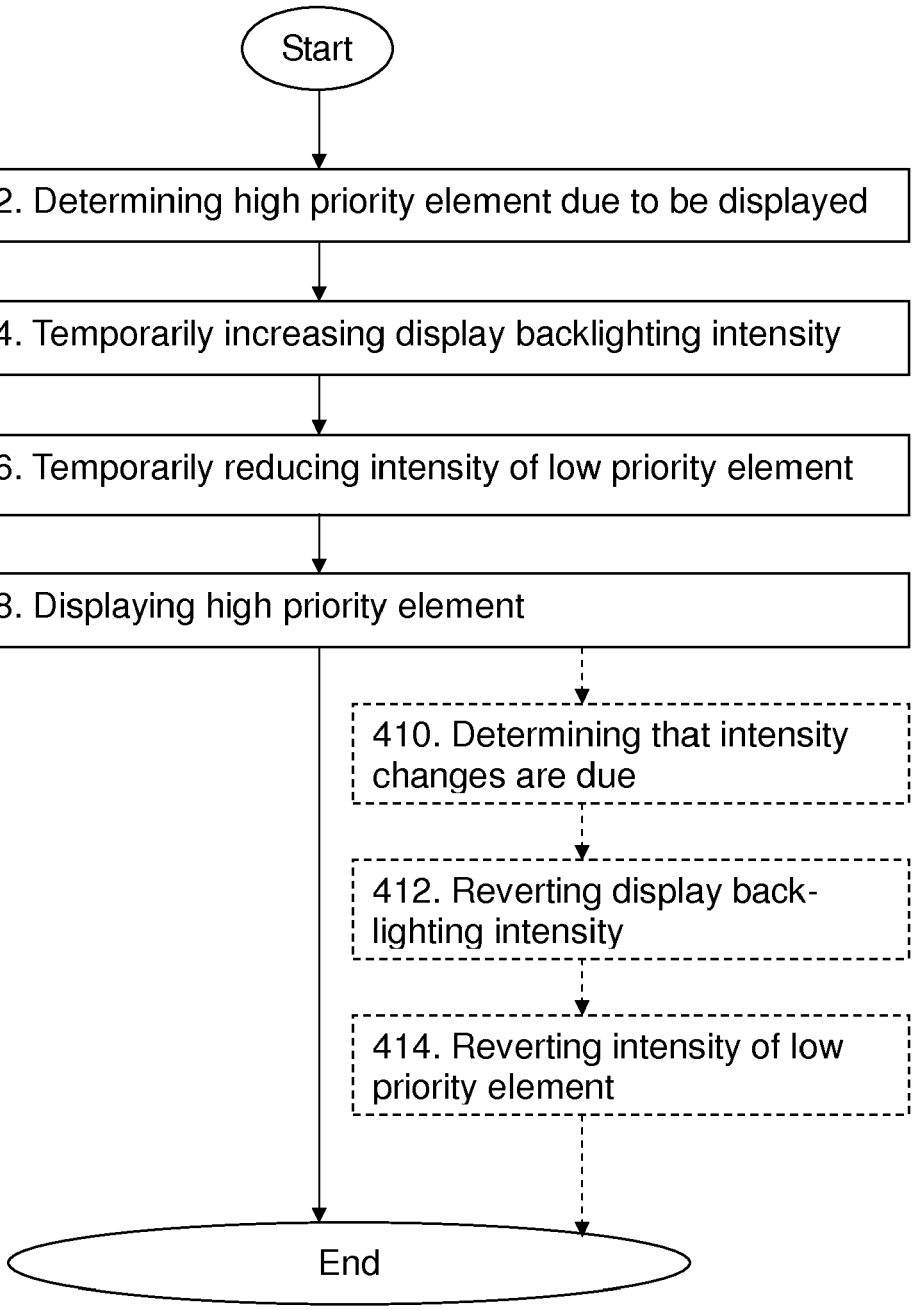
Start
402. Determining high priority element due to be displayed
404. Temporarily increasing display backlighting intensity
406. Temporarily reducing intensity of low priority element
408. Displaying high priority element
410. Determining that intensity changes are due
412. Reverting display back-lighting intensity
414. Reverting intensity of low priority element
End

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 13 15 9332

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Place of search	Date of completion of the search	Examiner
The Hague	21 June 2013	Bellatalla, Filippo

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