Title of the Invention: Additional assistance lights

Abstract Title: Superimposed additional assistance lights appearing as if on external vehicle

A system for providing additional assistance lights to a driver (figure 1, 14) comprises a camera (figure 2, 24) arranged to detect the position of the driver’s eyes, a sensor (figure 2, 26) arranged to sense an external vehicle 12, a display (figure 2, 28) arranged to display additional assistance lights, and a processor (figure 2, 30) connected to the camera, sensor and display and arranged to control the display to display additional assistance lights in a position that appears to the driver to be superimposed on the external vehicle. Preferably, the processor is further arranged to determine that the external vehicle is missing one or more lights and controls the display to display the determined missing lights in a position that appears to the driver to be superimposed on the external vehicle. The display may project light onto a windsren and/or a mirror of the driver’s vehicle.
Fig. 1
Fig. 2
Fig. 5

S5.1 DETECT POSITION OF DRIVER'S EYES

S5.2 SENSE AN EXTERNAL VEHICLE

S5.3 DISPLAY ADDITIONAL ASSISTANCE LIGHTS
ADDITIONAL ASSISTANCE LIGHTS

FIELD OF THE INVENTION

[0001] This invention relates to a system and method for providing additional assistance lights to a driver.

BACKGROUND

[0002] In road traffic environments if the lights of a vehicle are broken or if the driver of the vehicle does not action them correctly (for example they do not properly use their indicators or fog lights), then the drivers of other cars around the vehicle may be surprised by any unexpected movement this vehicle may undertake on the road and this could cause an accident. Despite the fact that all vehicles should be properly maintained and that the driver must obey traffic laws, the incorrect use of vehicle lights is a common occurrence with possibly severe consequences for other vehicles and individuals such as other drivers and pedestrians.

BRIEF SUMMARY OF THE INVENTION

[0003] According to a first aspect of the present invention, there is provided a system for providing additional assistance lights to a driver, the system comprising a camera arranged to detect the position of the driver’s eyes, a sensor arranged to sense an external vehicle, a display arranged to display additional assistance lights, and a processor connected to the camera, sensor and display and arranged to control the display to display additional assistance lights in a position that appears to the driver to be superimposed on the external vehicle.

[0004] According to a second aspect of the present invention, there is provided a method for providing additional assistance lights to a driver, the method comprising the steps of detecting the position of the driver’s eyes, sensing an external vehicle, and displaying additional assistance lights in a position that appears to the driver to be superimposed on the
external vehicle. A corresponding computer program is also provided for, when run on a
computer system, carrying out the method.

[0005] Owing to the invention, it is possible to simulate vehicle lights allowing other
vehicles to be promptly alerted of the unexpected vehicle movements in case a vehicle’s
lights are broken or the driver has forgotten to action them, for example. The system
provides a driver with additional assistance lights inside their vehicle, which are positioned
so that they appear to be superimposed on an external vehicle. In a simple example, if an
external vehicle in front is braking sharply, but the external vehicle’s braking lights are not
working, then the system will display additional “brake lights” in such a way that they are
perceived by the driver to be superimposed onto the external vehicle, for example by
projecting light onto the vehicle windscreen in the correct position. This allows the driver the
chance to react much quicker than they would otherwise be able to if they were relying
solely on their normal reactions, when they are not expecting a vehicle in front to be braking
without the vehicle’s braking lights being visible.

[0006] In a preferred embodiment, the system simulates the missing lights by using a
combined set of elements such as: a sensor/radar, a computer, an algorithm, an interior video
camera, and an on-windscreen display feature and/or a mirror display feature. Other optional
elements such as a GPS system, Google maps, vehicle characteristics to find the exact light
position, road sign reading and satellite data can also be used, for example for detecting that
the faulty vehicle is starting an unexpected movement such as stopping, turning, driving
without lights at night and so on.

[0007] For example, a GPS system and a mapping tool similar to Google Maps can be
used to deliver information that could assist the system in better defining the behaviour of a
vehicle in front. For example, if there is a sharp curve in the road and no side road to turn
into (which can be determined using GPS and a mapping tool), the fact that the system
analyses that the vehicle is slowing down and changing axle cannot be interpreted as a
vehicle likely to turn. Similarly, if the road is a one-way street (determined using GPS and a
mapping tool or from clear road signs), then the fact that a vehicle comes from the opposite
direction is not a normal case and the driver should be alerted by this forbidden action from
this vehicle with a simulating flashing high beam. If a road sign indicates that it is forbidden
to overtake and if the two sensors find a vehicle from the opposite direction and a vehicle
approaching fast from behind, it is likely that the vehicle from behind will try to overtake,
despite the interdiction and the danger with the vehicle in front. Simulating flashing high
beams from the vehicle behind will alert the driver that they need to slow down or to
accelerate a lot (which is the driver’s decision), in order to avoid the case where the three
vehicles would be at the same point at the same time.

[0008] The external sensors (which could be cameras) are able to identify shapes and to
associate them with their database content that would contain all vehicles produced by the
vehicle manufacturers. Each time there is a match, the simulation of the lights can be
improved by better positioning them at the expected place on the other vehicle.

[0009] The improved system has a number of advantages. There is no need for
communication between vehicles, there is no interaction with the vehicle equipment or
lights, all decisions belong to the driver and the system brings a new valuable security and
comfort feature to vehicle drivers, for use when confronted by faulty vehicles or negligent
drivers. The system provides value in that it is likely to decrease traffic risks and increase
driver’s comfort values, may smooth the traffic by avoiding unexpected reactions and is not
intrusive, since it is not altering vehicle functions, there is no need for any installation on
other vehicles and is not standard-dependent. The system could be personalized by the
drivers, for example where light intensities or indicator speed may vary depending on the
above parameters and the likelihood that the vehicle does not have the correct lights and
could also possibly be applied to pedestrians jumping in the road.

[0010] The system can also be advantageously improved if combined with one or more
of a GPS system, Google maps, vehicle characteristics to find the exact light position, road
sign reading and a satellite system.

[0011] Preferably, the processor is further arranged to determine that the external vehicle
is missing one or more lights and to control the display to display the determined missing
lights in a position that appears to the driver to be superimposed on the external vehicle. As
mentioned above, one of the best uses of the system is to detect that an external vehicle in
front has one or more lights that are not working or are not being used correctly. The system can then provide additional assistance lights that mimic the behaviour of the missing lights, such as brake lights and indicator lights (used when turning). This allows the driver of the following vehicle, which is using the system, to be warned visually about the vehicle in front, but also in a manner that is non-intrusive and fits with what the driver is expecting and used to seeing in relation to other road vehicles.

[0012] Advantageously, the processor is further arranged to detect a change in speed and/or direction of the external vehicle and to control the display to display the additional assistance lights in response to the detected change in speed and/or direction of the external vehicle. The processor can be arranged so that the data that is received from the sensor can be used to determine information about the external vehicle’s speed and movement and this can then be used to inform the choices about which additional assistance lights to show to the driver. Movement or changes in speed that would normally be accompanied by vehicle lights, but which do not actually have the lights used correctly can be very dangerous for other road users. The system is able to assist drivers in this scenario.

[0013] Ideally, the display that is arranged to display additional assistance lights comprises a projection device arranged to project the additional assistance lights onto a windscreen and/or a mirror of the driver’s vehicle. The use of a projection device to provide the actual light output provides a simple and efficient way that the system can provide the additional assistance lights to the driver, without the need for extensive modification to the driver’s vehicle. The projection device can project additional lights onto the windscreen of the vehicle, for example, which will be seen by the driver as lights that are superimposed on the vehicle in front.

[0014] Preferably, the system further comprises one or more additional sensors arranged to sense one or more additional external vehicles, the processor arranged to control the display to display additional assistance lights in a position that appears to the driver to be superimposed on the one or more additional external vehicles. Although the driver of the vehicle is most usefully assisted by a forward-facing sensor used to detect vehicles in front of the driver’s vehicle, one or more additional sensors can also be used, for example to
detect vehicles that are currently running behind the driver’s vehicle. A fast-approaching vehicle from behind that is not using its lights in dark conditions, for example, could be dangerous and the system can be controlled to generate additional assistance lights for such an external vehicle, which will add the lights to the view seen in the driver’s rear mirrors. Sensors can also be used to detect external vehicles that are joining the current road from the side, although these could also be detected with a single forward-facing sensor. Different colours can be used to indicate vehicles from behind. For example a vehicle in front that is braking without lights can have traditional red lights added at the correct place on the rear of the external vehicle, while a vehicle approaching from behind can have lights added in a green colour that are seen in the driver’s rear facing mirrors. This will avoid confusing the driver about the source of the additional lights.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Preferred embodiments of the present invention will now be described, by way of example only, with reference to the following drawings, in which:-
Figure 1 is a schematic diagram of two vehicles,
Figure 2 is a schematic diagram of a system for providing additional lights,
Figures 3a and 3b are schematic diagrams of a view from a vehicle,
Figure 4 is a further schematic diagram of two vehicles,
Figure 5 is a flowchart of a method of operating the system, and
Figure 6 is a schematic diagram of three vehicles.

DETAILED DESCRIPTION OF THE DRAWINGS

[0016] Figure 1 is a schematic diagram of two vehicles 10 and 12. A driver 14 of the first vehicle 10 is shown and the vehicle 12 is an external vehicle 12 with respect to the driver 14 of the first vehicle 10. In this Figure, the vehicle 10 is behind the external vehicle 12, as both vehicles 10 and 12 are travelling along a road 16, with the large arrow indicating the direction of travel. The external vehicle 12 is fitted with brake lights 18 as is conventional in road vehicles, as by law in virtually all countries of the world certain
specific lights 18 have to be fitted to all vehicles in order that they be considered road worthy.

[0017] On the rear of most vehicles are fitted red night lights, red fog lights, red brake lights, white reversing lights and orange indicator lights. These lights must be in working order and used correctly by the driver in the appropriate circumstances. However it is a widespread problem that many drivers, either accidently or deliberately, do not use their lights as they should (it is common for example for drivers to not use indicators correctly when turning). It is also the case that lights on the rear of a vehicle may not be working correctly, as bulbs will wear out over time, and the driver of the vehicle may not be aware of the faulty bulb.

[0018] To assist the driver 14 of the vehicle 10, a system for providing additional assistance lights to the driver 14 is fitted to this vehicle 10. The purpose of this system is to warn the driver 14 about changes to the external vehicle 12 by providing additional lights, which are likely to be noticed by the driver 14 faster than they would otherwise notice the changes in the external vehicle 12, without the additional assistance lights. In the preferred embodiment of the system a projector inside the vehicle 10 will project lights onto the vehicle’s windscreen 20 in such a position that they appear to the driver 14 to be superimposed on the external vehicle 12.

[0019] Figure 2 shows schematically the principal components of the system 22 for providing the additional assistance lights to the driver 14. The system comprises a camera 24 which is arranged to detect the position of the driver’s eyes, a sensor 26 which is arranged to sense the external vehicle 12, a display 28 which is arranged to display the additional assistance lights, and a processor 30 which is connected to the camera 24, sensor 26 and display 28. The components of the system 22 can be retro-fitted to the vehicle 10 and do not require any communication with any external components in order to provide the necessary functionality as the system 22 is a standalone system.

[0020] The processor 30 is arranged to control the display 28 to display the additional assistance lights in a position that appears to the driver 14 to be superimposed on the external vehicle 12. In a preferred embodiment of the system 22, the display 28 comprises a
projection device which is arranged to project the additional assistance lights onto a windscreen 20 and/or a mirror of the driver’s vehicle 10. The driver 14 will see the additional assistance lights superimposed onto the external vehicle 12 and will appear to the driver 14 as if those additional lights originate with that external vehicle 12 even though they are generated by the system 22.

[0021] The system 22 provides the driver 14 with warning indications via the additional assistance lights that are generated by the display 28. These warning indications are designed to assist the driver 14 in a way that will fit the driver’s expectation as to the normal provision of lights by external vehicles. The system 22 does not provide any changes to the normal operation of the driver’s vehicle 10, all other aspects of the vehicle 10 are unchanged by the presence of the system 22, which solely operates to provide additional assistance lights to the driver 14. These lights will allow the driver 14 to react quicker than they otherwise would be able to do.

[0022] Figures 3a and 3b illustrate the system 22 in use, as seen through the windscreen 20 of the driver’s vehicle 10. An external vehicle 12 is braking, caused by the driver of the external vehicle 12 slowing the vehicle down by pressing the brake pedal, without the necessary external lights on the external vehicle 12 being illuminated, as shown in Figure 3a. It can be assumed that the vehicle brake lights of the external vehicle 12 are faulty and this is dangerous for other drivers who are following the external vehicle 12 as they will not immediately detect the decreasing speed of the vehicle 12 in front, since they are used to the brake lights being illuminated to warn other road users that the external vehicle 12 is slowing down.

[0023] The sensor 26 of the system 22 is permanently calculating the speed of the vehicle 12 in front of the driver 14. The sensor 26 detects that the external vehicle 12 is slowing down while the driver 14 does not see any stop lights illuminated. The sensor 26 is far quicker than the driver 14 in detecting the change in speed of the external vehicle 12. Even if this speed advantage is only one second this is enough to make a difference to the driver 14 of the following vehicle 10. The processor 30 is operating an algorithm and this
algorithm indicates that the processor 30 should simulate the stop lights of the external vehicle 12.

[0024] The video camera 24 finds where the driver's eyes are located and using trigonometry calculations enables the processor 30 to calculate the windscreen spots located in between the driver's eyes and the vehicle stop lights. The on-windscreen display 28 shows red lights 32, as shown in Figure 3b, at the calculated spots on the windscreen 20 that the driver 14 will immediately see for action by the driver 14. In this way additional assistance lights 32 are created, which are superimposed onto the external vehicle 12, which will seem to the driver 14 as if they are the normal working brake lights of the vehicle 12 in front. This helps the driver 14 respond to the braking of the vehicle 12 in front.

[0025] Figure 4 is a view similar to Figure 1 of the driver 14 in a vehicle 10 that is following an external vehicle 12. Figure 4 explains the trigonometry used to determine the positioning of the additional assistance lights 32. Four distances labelled A to D are used by the system 22 in the calculation of the positioning of the lights 32. A is the distance between the vehicles 10 and 12, B is the distance and angle between driver's eyes and video camera 24, C is the distance and angle between driver's eyes and the missing vehicle lights and D is the distance and angle between the windscreen spots and the display 28 used to display the lights 32. All other distances and angles inside the vehicle are known from the vehicle manufacturer, enabling all trigonometric calculations.

[0026] The sensor 26 evaluates vehicle distance, speed, axel difference versus vehicle going straight on, and detects a metallic mass without lights. The interior video camera 24 is used to find the driver's eye position and the processor 30 and its algorithm use trigonometry to find the windscreen spot(s) to be illuminated.

[0027] The system 22 can be used in many different situations. At night or with fog the system 22 can be used to simulate lights that are missing (for example low beams and fog lights). In relation to vehicles in front, the system 22 can be used to create stop/brake lights and indicators. For vehicles from behind, the system 22 can be used to highlight beams if a vehicle is coming too fast. For vehicles from side roads at intersections, if the driver 14 has
priority then highlight beams if the side vehicle is physically unable to stop or if the driver 14 does not have priority the system can simulate stop light of all vehicles in front if the speed is too high to respect the priority. In relation to vehicles coming from the opposite direction, the system 22 can simulate indicators, stop/brake lights (in front of the vehicle with a blue light) as it may trigger a sliding movement, and simulate high beams if the vehicles overtakes and crosses the middle straight line between lanes.

[0028] Figure 5 shows a flowchart that summarises the method for providing additional assistance lights 32 to the driver 14 of a vehicle 10 in relation to an external vehicle 12. The method comprises the steps of, firstly step S5.1, which comprises detecting the position of the driver’s eyes with the camera 24, secondly step S5.2, which comprises sensing the external vehicle 12 with the sensor 26, and finally step S5.3, which comprises displaying additional assistance lights 32, with the display 28, in a position that appears to the driver 14 to be superimposed on the external vehicle 12. In the preferred embodiment, the display is a projector that displays the lights 32 on the vehicle’s windscreen 20.

[0029] The processor 30 is connected to the camera 24, sensor 26 and display 28 and is arranged to control the display 28 in order to display the additional assistance lights 32 in a position that appears to the driver 14 to be superimposed on the external vehicle 12. The processor 30 provides the intelligence in the system 22 and can be implemented in a number of different ways. In the simplest form, the processor 30 is contained within a dedicated black box that is also provided with other components such as a power supply and wireless capability to communicate with the other elements in the system 22. The processor 30 runs the necessary algorithms to determine when and where the additional lights 32 are to be provided.

[0030] As discussed above, the system 22 can be used in many different situations. For example, the system 22 can be used at night or with fog to display a grey mark on the windscreen 20 if the approaching vehicle lights are too strong. For vehicles in front, the system 22 can be used to illuminate stop/brake lights in green indicating that the vehicle in front is strongly accelerating, leaving room for the same type of behaviour. For vehicles behind, the system 22 can highlight beams in green indicating that the vehicle is running at a
lower speed, authorizing the driver 14 to change lanes (to overtake for instance) without any risk. For vehicles from side roads at intersections, the system 22 can illuminate a green light on the beams if the vehicle speed is decreasing to allow a stop at the intersection.

[0031] Figure 6 shows a top plan view of three vehicles, the middle vehicle 10 being fitted with the system 22 and the other two external vehicles 12 being normal road users that do have any modifications to their vehicles 12. The system 22 installed in the vehicle 10 has an additional sensor 34 fitted at the rear of the vehicle 10, in addition to the sensor 26 fitted at the front of the vehicle 10. The additional sensor 34 is specifically designed to monitor vehicles that are travelling behind the vehicle 10. The additional sensor 34 is connected to the processor 30, which receives the data from the sensor 34 and uses that data in the algorithms run by the processor 30.

[0032] The system 22, in this embodiment, is arranged to monitor external vehicles 12 that are in front and behind the driver’s vehicle 10. In addition to providing additional assistance lights 32 utilising the driver’s windscreen 20, the system 22 will provide additional assistance lights 32 in the mirrors 36 of the vehicle 10. The additional assistance lights 32 that are provided in the mirrors 36 for the external vehicle 12 that is behind the current vehicle can be coloured green, in order to indicate to the driver 14 that these lights relate to vehicles behind. As before, these additional assistance lights will be superimposed on the vehicle in question, from the driver’s point of view.

[0033] The system 22 simulates vehicle lights allowing the driver 14 to be promptly alerted of any unexpected vehicle movements. The system 22 provides a driver 14 with additional assistance lights 32 inside their vehicle 10, which are positioned so that they appear to be superimposed on the external vehicle 12. This allows the driver 14 the chance to react much quicker than they would otherwise be able to if they were relying solely on their normal reactions. The driver’s normal interactions with their vehicle 10 are not affected by the presence of the system 22, which is designed to provide warnings in a way that meets the driver’s expectations of their normal interactions.

[0034] Although the system 22 has been described above primarily in respect of use by a car driver 14, drivers of other vehicles could also use the system. For example, the system
could be used by the driver of a motorcycle. The four principal components of system 22 are sufficiently compact that they can be carried on a motorbike. The display 28 can project additional assistance lights 32 for the bikers on their helmet wind screen. The position of the sensor 26 would be on the bike, with the camera 24 used to define the helmet position with regard to the axle (bottom-up in front of the bike) so that the display would be projected at the right position. The system 22 could also work for trains with regard to cars (mainly at road-rail crossing) similarly to a car coming too fast from a side road and unlikely to respect a stop, which in the case of a train, would be the barrier. The system 22 may also applied to ships with regard to their normal behaviour and navigation rules.
CLAIMS

1. A system for providing additional assistance lights to a driver, the system comprising:
   a camera arranged to detect the position of the driver’s eyes,
   a sensor arranged to sense an external vehicle,
   a display arranged to display additional assistance lights, and
   a processor connected to the camera, sensor and display and arranged to control
   the display to display additional assistance lights in a position that appears to the driver to be
   superimposed on the external vehicle.

2. A system according to claim 1, wherein the processor is further arranged to
determine that the external vehicle is missing one or more lights and to control the display to
display the determined missing lights in a position that appears to the driver to be
superimposed on the external vehicle.

3. A system according to claim 1 or 2, wherein the processor is further arranged to
detect a change in speed and/or direction of the external vehicle and to control the display to
display the additional assistance lights in response to the detected change in speed and/or
direction of the external vehicle.

4. A system according to claim 1, 2 or 3, wherein the display arranged to display
additional assistance lights comprises a projection device arranged to project the additional
assistance lights onto a windscreen and/or a mirror of the driver’s vehicle.

5. A system according to any preceding claim, and further comprising one or more
additional sensors arranged to sense one or more additional external vehicles, the processor
arranged to control the display to display additional assistance lights in a position that
appears to the driver to be superimposed on the one or more additional external vehicles.

6. A method for providing additional assistance lights to a driver, the method
comprising the steps of:
detecting the position of the driver’s eyes, 
sensing an external vehicle, and 
displaying additional assistance lights in a position that appears to the driver to be superimposed on the external vehicle.

7. A method according to claim 6, and further comprising determining that the external vehicle is missing one or more lights and displaying the determined missing lights in a position that appears to the driver to be superimposed on the external vehicle.

8. A method according to claim 6 or 7, and further comprising detecting a change in speed and/or direction of the external vehicle and displaying the additional assistance lights in response to the detected change in speed and/or direction of the external vehicle.

9. A method according to claim 6, 7 or 8, wherein the step of displaying additional assistance lights comprises projecting the additional assistance lights onto a windscreen and/or a mirror of the driver’s vehicle.

10. A method according to any one of claims 6 to 9, and further comprising sensing one or more additional external vehicles and displaying additional assistance lights in a position that appears to the driver to be superimposed on the one or more additional external vehicles.

11. A computer program comprising instructions for carrying out all the steps of the method according to any preceding method claim, when said computer program is executed on a computer system.
**Patents Act 1977: Search Report under Section 17**

**Documents considered to be relevant:**

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<th>Category</th>
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<th>Identity of document and passage or figure of particular relevance</th>
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<td>X</td>
<td>1, 3-6 and 8-11</td>
<td>US2012/268262 A1 (HONDA MOTOR CO LTD) See especially figure 3 and the corresponding description starting at paragraph [0054].</td>
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<td>JP2010134639 A (HONDA MOTOR CO LTD) See especially figure 7 and WPI abstract accession no. 2010-G81272.</td>
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<td>JP2013196359 A (HONDA MOTOR CO LTD) See especially figure 7 and WPI abstract accession no. 2013-P31258.</td>
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<td>EP2689966 A1 (CLOUDCAR INC) see especially figure 4.</td>
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**Categories:**

- **X** Document indicating lack of novelty or inventive step
- **Y** Document indicating lack of inventive step if combined with one or more other documents of same category.
- **&** Member of the same patent family
- **A** Document indicating technological background and/or state of the art.
- **P** Document published on or after the declared priority date but before the filing date of this invention.
- **E** Patent document published on or after, but with priority date earlier than, the filing date of this application.

**Field of Search:**

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X^:

- Worldwide search of patent documents classified in the following areas of the IPC
  - B60Q, G08G

The following online and other databases have been used in the preparation of this search report

- WPI, EPODOC
### International Classification:

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