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GB 2215040 A EP 0284225 A1 WO 89/07537 A1
US 5293427 A US 5218387 A US 4144531 A

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(54) Vehicle safety device to warn driver of fatigue

(57) A vehicle comprises a camera for monitoring the driver, an image processor for monitoring a characteristic of the driver's physiological state as an indication of the driver's level of fatigue, and means for alerting the driver when said level exceeds a predetermined value associated with said characteristics. The head of the driver may be monitored eg in respect of the frequency of eye-blinking, eye-rolling, nodding of the head or extent of closure of the eyes.

GB 2 284 582 A

SAFETY DEVICE

This invention relates to safety devices and in particular to a device which alerts an individual to the fact he is in a fatigued or tired state.

Sleepiness in a hazardous environment can be highly dangerous. Such dangerous situations are experienced by machine operators, chemical plant works and drivers of motor vehicles, especially if driving on a motorway.

There are no reliable systems currently available which can alert an individual to the fact that he is in danger of falling asleep. The general feeling of tiredness can creep up individuals, and small sleep events called "microsleeps" can occur where an individual loses consciousness momentarily and is unaware of it.

In a vehicle, unlike other dangerous situations of the type described above, the operator/driver is in a fixed position and is not required to wear face protection. According to the present invention, this is utilised by providing a camera for monitoring the driver, an image processor for monitoring a characteristic of the driver's physiological state as an indication of the driver's level of fatigue, and means for alerting the driver when said level exceeds a predetermined value associated with said characteristics. The relevant level of fatigue can be determined by parameters such as frequency of blink rate, the percentage of the eye area occluded by the eyelids, eye-rolling frequency, etc. An image-processing unit is provided, to determine that physiological signs of fatigue are being exhibited by the individual being monitored. A warning or alert can be given. For example, an alarm bell could operate or a visual signal could be achieved.

A system according to the invention may comprise a camera, camera lens, image-processing electronics and image-tracking systems so that, for example, the face of the subject can be kept in the field of view of the camera continually. Nothing needs to be attached to the individual's body, unlike a device recording brainwave

activity or galvanic skin response. The system relies on collecting "visual" data by a non-invasive method and can operate in darkness and view through glass by using a polariser on the lens.

The components of the novel system can be fitted into a small box, and so are readily portable and easily fitted to a number of sites. The system can therefore be concealed, if this is needed.

In use, the device needs to have its "target" assigned. When this is done, the equipment monitors the target, e.g. the head and notes the changes in it. Examples can be blinking, nodding, etc. The rate and magnitude of these changes can be measured and, if the measured value passes a certain level, then a warning system can be activated.

To detect when a driver has fallen asleep, image processing can detect whether the facial area is no longer fully visible or, in a higher resolution system, whether the eyes are closed. If the eyes remain shut over a period of time, it is a fair indication that the driver has fallen asleep.

Alternatively or in addition, the facial area may be monitored. If it is obscured from view for any long period of time, this can be taken as a reliable indication that the head has slumped onto the chest or slipped back against the headrest, indicating that the driver has fallen asleep. This would then give a positive test result, causing the alarm system to be activated.

Image processing can detect differences in contrast and difference in brightness, and can these can be exploited both for:

1. detecting whites of eyes as opposed to eyelids, and
2. detecting the face being directed towards the windscreen as opposed to the top of the head or underneath of the chin, both which have

different reflectivities and brightnesses of image.

More sophisticated techniques can be used to detect fatigue, but the above technique would reliably indicate when a driver's head had dropped to a level which was unusual when driving, indicating sleep. The processing system can be modified, as required, to prevent false alarms when the driver is looking over the shoulder.

By way of example, the processing system may be programmed to give an alert, for a period of eyes being completely closed lasting more than 3 seconds. When first entering the vehicle, the driver would activate the system and hold the head steady until the device had calibrated itself to deal with the relative contrasts between the face and hair. This can be updated as time goes on throughout the day, to allow for slow changes in lighting conditions.

At night, the face could be illuminated with an array of infra-red diodes, so preventing distraction to the driver, and enabling this difference in contrast to be measured even when no visible light is present.

CLAIMS

1. A vehicle comprising a camera for monitoring the driver, an image processor for monitoring a characteristic of the driver's physiological state as an indication of the driver's level of fatigue, and means for alerting the driver when said level exceeds a predetermined value associated with said characteristics.

2. A vehicle according to claim 1, wherein the characteristic is the frequency of eye blinking.

3. A vehicle according to claim 1, wherein the characteristic is eye-rolling.

4. A vehicle according to claim 1, wherein the processor monitors the fraction of an eye covered by eye-lids.

5. A vehicle according to claim 1, wherein the characteristic is the head nodding either forwards or backwards, out of position.

6. A vehicle according to claim 1, wherein the characteristic is the eyes' closing.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)	Application number GB 9423501.7
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Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE: WPI	Documents considered relevant following a search in respect of Claims :- 1-6

Categories of documents

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

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2215040 A	(RITCHIE)	1,6 at least
X	EP 284225 A1	(RASAAT)	1,6 at least
X	WO 89/07537 A1	(MESSERSCHMIDT)	1 at least
X	US 5293427	(UENO ET AL)	1 at least
X	US 5218387	(UENO ET AL)	1,2 at least
X	US 4144531	(ANBERGEN)	1,2 at least

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