

FORM 2

THE PATENTS ACT, 1970

(39 OF 1970)

AND

THE PATENT RULES, 2003

COMPLETE SPECIFICATION

(See section 10 and rule 13)

“A SYSTEM FOR MONITORING A DRIVER OF A VEHICLE”

Name of Applicants	Nationality	Address
Indra Vijay Singh	Indian	Assistant Professor, Department of Electronics & Communication Engg., ITM University Gwalior (MP)-474001.
Amlan Basu	Indian	M.Tech, Student, Department of Electronics & Communication Engg., ITM University Gwalior (MP)-474001.
Kundan Kumar Jha	Indian	B.Tech Student, Department of Electronics & Communication Engg., ITM University Gwalior (MP)-474001.

The following specification particularly describes the invention and the manner in which it is to be performed.

FIELD OF THE INVENTION

The present invention relates generally to a system for monitoring a driver of a vehicle to determine at least one characteristic, condition, property and/or state of the driver, for example, whether the driver is falling asleep or otherwise unable to operate the vehicle.

BACKGROUND

There are many devices for preventing a driver from falling asleep. Some of the devices monitor the driver's head position, and send an alert when the driver's head is tilted forward. For example, U.S. Pat. No. 5,684,461 describes a sleep prevention device for a driver of a vehicle. The device is comprised of a head set, a mercury switch, an alarm indicator having a speaker for emitting a vocal alarm, a volume control dial, a light emitting diode, a 12 volt adapter and a flexible pouch. The head set is placed on the head of the driver, and the mercury switch is within a housing that is attached to the headset. The mercury switches senses when the driver's head is tilted forward and thereupon sends an activation signal. A mercury switch has sealed glass housing. In one end of the housing there are two electrodes. The first electrode is placed at a short distance from the second electrode. Within the housing there is a small amount of mercury. When the driver's head is in a predetermined range of deviation from the horizontal, the mercury moves into contact with the two electrodes and closes an electrical circuit across the electrodes. The activation signal activates the speaker, which emits a vocal alarm. A disadvantage of this device is its complexity and its use of many separate parts. Another disadvantage of this device is the use of a vocal alarm to notify

the driver that he is falling asleep. Sending a vocal alarm is not efficient when the driver is in a noisy environment, or when the driver activates a radio, a C.D. player, a tape player or any other apparatus which produces sound and/or noise. A further disadvantage of this device is the need to connect it to an external power supply source.

There are several different vehicular situations that are lumped together and called the distracted or inattentive driver problem. These situations include cases where the driver is wide-awake but eating, putting on make-up, texting and talking on the phone; cases where the driver is physically fatigued and may or may not also be sleepy; medical condition cases where the driver suffers a medical condition such as a stroke or heart attack; cases where the driver is under the influence of alcohol or drugs; and cases where the driver is just sleepy. At least one embodiment of the present invention is primarily concerned with detecting a drowsy or sleepy driver but a number of the other causes of the distracted driver also affect the parameters that are the focus of embodiments of the invention and thus will also be addressed, and are encompassed within the scope of the invention in its entirety.

A primary focus of at least one embodiment of the present invention is to measure the heartbeat rate and respiration rate of the driver using electric fields or optics, and through analysis of these rates, predict whether the driver is losing his/her ability to safely operate the vehicle. Driver inattention is a larger problem than driving sleepiness and fatigue.

A large number of patents and technical papers address systems for detection of drowsy driver but despite the potential for such systems, researchers have been largely unsuccessful in finding a feasible way to identify sleepiness or inattention.

Nevertheless, it has been demonstrated that this can be done using an EEG. As one study reported “By combining power spectrum estimation, principal component analysis and artificial neural networks, we show that continuous, accurate, non-invasive, and near real-time estimation of an operator’s global level of alertness is feasible using EEG measures.” (Estimating Alertness from the EEG Power Spectrum, January, 1997). However, attaching electrodes to a driver is intrusive and is not a practical solution to drowsiness detection. The disclosure below uses at least one electrical, physical, chemical and/or biological property of a driver, such as can be obtained by EEG- and EKG-signals, respiration, oxygen saturation, temperature, perspiration, etc., to reliably determine drowsiness in time to prevent accidents, see, for example, U.S. Pat. No.7,215,991. This is accomplished unobtrusively without physically interacting and contacting with the driver, i.e., without attaching electrodes to the driver.

Another recently introduced product makes use of a cap which places electrodes on the skull or the operator and measures an approximate EEG and from the measurements attempts to determine whether the operator is fatigued.

U.S. Pat. No. 7,822,453 further shows that an oximetry sensor can work on the forehead, although this is done by placing the sensor on the forehead. In addition, U.S. Pat. Appln. Publ. No. 20080045847 discloses that a non-contact, passive method for measurement of arterial pulse from areas such as the major superficial arteries of the body through analysis of thermal IR images acquired by passive thermal IR imaging sensors. The output waveform readily contains the information on heart rate, cardiac interbeat intervals, heart-rate variability and other features inherent in arterial pulse.

Other methods in the prior art are set forth in the following patent publications. U.S. Pat. No. 7,666,151 discloses use of piezoelectric film placed on a seat or bed surface that obtains a measure of both heartbeat and respiration rates. In this application, this concept is extended in what is considered an unobvious manner to use of a fluid-filled bladder weight sensor and load cell weight sensors as further methods of obtaining the heartbeat and respiration rates. Recently, The Plessey corporation has announced an EPIC ECG sensor (PS2501) which can be held in the hands of a patient and obtains the ECG signal. There is indication that this or a similar sensor can also do so if it is placed in the seatback in close proximity to the back of the driver. By whatever method is used, the analysis of these signals to obtain a measure of drowsiness is not believed to have previously been applied.

Various solutions to detecting a drowsy driver or one that is having a heart attack, stroke or other health related event are disclosed in U.S. patents and published applications assigned to the assignee of this invention or its affiliated company, all of which are incorporated herein by reference, including: U.S. Pat. Nos. 5,829,782, 5,845,000, 20070025597, U.S. Pat. Nos. 6,116,639, 7,887,089, 7,769,513, 6,513,833, 7,660,437, 7,009,502, 6,950,022, 7,788,008, 7,676,062, 7,738,678, 6,793,242, 7,596,242, assigned at issuance to Automotive Technologies International, Inc. and 20080195261, U.S. Pat. Nos. 7,629,899, 7,983,802, and 7,295,925 assigned at issuance to Intelligent Technologies International, Inc. In these patents and published applications, the methods disclosed are optical, radar and driving behaviour related, for example, to maps.

U.S. Pat. Appl. No. 20080214903A1 disclosed a system and method for monitoring one or more physiological parameters of a user. The system of the invention includes wearable sensor modules sensing the physiological parameters. One or

more transmitters wirelessly transmit signals indicative of values of physiological parameters to a mobile monitor. The mobile monitor includes a processor processing the signals received from the transmitter in real time using expert knowledge. A device provides one or more indications of results of the processing. The disadvantages of the prior art are that the inventors have used Bluetooth, Wi-Fi or wireless LAN to transmit the data. The physical range of Bluetooth is typically less than 10m, up to 100m. The highest range of Wi-Fi is 32 meter (105 ft.). The highest range of wireless LAN is up to 50 meter. So, when the device is being deployed in the car then the signal can be received to the receiver for a limited range. The complete receiver has made using different hardware which is very complex and costly. Lots of man power required to monitor the several received data more over they must be skilled or expert to do the same

However, the above said methodologies are quite complex and impractical owing to cost concerns and complexities involved. Hence it is the objective of the present invention is to provide a heart monitoring system that can monitor the physical status of the car driver including his/her vital functions such as heart rate etc.

ADVANTAGES OF THE INVENTION

An advantage of the invention is that it provides a compact device for preventing a driver from falling asleep.

Another advantage of the invention is that it provides a system for preventing a driver from falling asleep, which is effective even when the driver is in a noisy environment.

Yet another advantage of the invention is the system is portable and can be installed anywhere in the car as per the manufacturer's or customer's wish.

Yet another advantage of the invention is the provision of GSM module that is an SIM based module and totally depends on network and need not need to be adjusted as it can transmit data from anywhere it is placed. There is used only a single GSM module interfaced with microcontroller so as to transfer the heartbeat reading. The GSM module that has unlimited range as it works on the network of a particular company responsible for providing the network.

Yet another advantage of the invention is that system has GSM module which can accept any GSM SIM of any telecom company and can transmit the data using the network of the company the SIM belongs to.

Yet another advantage of the invention is that system can be placed in such a way that even the driver cannot see the system's location only the driver has to put on the wire which help to sense the heart beat which will never become an irritation for the driver.

Yet another advantage of the invention in the system is that there is no special station needed to be set up as the whole data will be received on a cellular phone whose SIM number is feed in the system.

Further, yet another advantage of the invention is that the system is required to be installed at any single suitable place of the car where it is safe and sound to work.

Further, yet another advantage of the invention is that in the system the heartbeat is sent in numeric forms which even a layman can understand and compare it with the normal heartbeat numeric rate.

Furthermore, yet another advantage of the invention is that in the system is comparatively less costly as compared to the existing devices or system and is very much affordable for the customer.

Furthermore, yet another advantage of the invention is that system is based on embedded systems that is also used in the automation work and wireless communication.

Furthermore, yet another advantage of the invention is that not much man power is required and also it is not mandatory that the person monitoring the cellular phone should be skilled or expert.

The process of the invention with the features of the main claim has the advantage that the accuracy of the driver state detection is significantly improved.

By monitoring driver heartbeat rates, a determination can be made as to whether the driver is drowsy and at risk of falling asleep and/or whether he or she is experiencing a health event that could interfere with his or her ability to operate a vehicle.

BRIEF DESCRIPTION OF THE INVENTION

The present invention is completely based on an embedded system. The invention is based on embedded a system that is also used in the automation work and wireless communication. A heart rate meter and a finger print module are implemented which helps to monitor the safety of the car by simply monitoring the driver's heart rate and the finger print which is being registered with a monitoring company.

In the present invention, two microcontrollers are used. One microcontroller (AT89S52) is used to monitor the heart rate measurement and the other one (AT89S52) is interfaced with the finger print scanner. For detecting the heart rate the

concepts of photoplethysmography is used. Photoplethysmography is the process of optically estimating the volumetric measurement of an organ. When the heart expands the volume of blood inside the finger tip increases and when the heart systole the volume of blood inside the finger tip decreases. The resultant pulsing of blood volume inside the finger tip is directly proportional to the heart rate and the pulses is counted for one minute duration with the help of microcontroller to compute the heart rate of the car driver.

This object is accomplished in accordance with the illustrated preferred embodiment of the present invention by providing an embedded system. A heart rate meter and a finger print module are implemented which helps to monitor the safety of the car by simply monitoring the driver's heart rate and the finger prints.

Another aspect of the disclosure provides methods of determining a user's heart rate by using a finger print module.

BRIEF DESCRIPTION OF THE DRAWING

Figure 1 illustrates the block diagram of the device that is installed in the vehicle for monitoring the physical status of the driver according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

While the present invention is described herein by way of example using several embodiments and illustrative drawings, those skilled in the art will recognize that the invention is not limited to the embodiments of drawing or drawings described, and are not intended to represent the scale of the various components. Further, some components that may form a part of the invention may not be illustrated in certain

figures, for ease of illustration, and such omissions do not limit the embodiments outlined in any way. It should be understood that the drawings and detailed description thereto are not intended to limit the invention to the particular form disclosed, but on the contrary, the invention is to cover all modification/s, equivalents and alternatives falling within the spirit and scope of the present invention as defined by the appended claims. The headings used herein are for organizational purposes only and are not meant to be used to limit the scope of the description or the claims. As used throughout this description, the word "may" is used in a permissive sense (i.e. meaning having the potential to), rather than the mandatory sense (i.e. meaning must). Further, the words "a" or "an" mean "at least one" and the word "plurality" means one or more, unless otherwise mentioned. Furthermore, the terminology and phraseology used herein is solely used for descriptive purposes and should not be construed as limiting in scope. Language such as "including," "comprising," "having," "containing," or "involving," and variations thereof, is intended to be broad and encompass the subject matter listed thereafter, equivalents, and additional subject matter not recited, and is not intended to exclude other additives, components, integers or steps. Likewise, the term "comprising" is considered synonymous with the terms "including" or "containing" for applicable legal purposes. Any discussion of documents, acts, materials, devices, articles and the like is included in the specification solely for the purpose of providing a context for the present invention. It is not suggested or represented that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present invention.

In this disclosure, whenever a composition, an element or a group of elements is preceded with the transitional phrase "comprising", it is understood that we also contemplate the same composition, element or group of elements with transitional phrases "consisting essentially of", "consisting", "selected from the group of consisting of", "including", or "is" preceding the recitation of the composition, element or group of elements and vice versa.

With reference to the drawings, in Figure1 shows a physiological monitoring system, in accordance with an embodiment of the invention.

The present invention concerns a device and method for detection of drowsiness of a person, such as a machine operator, pilot, driver or conductor, wherein a heart rate of the person are measured and monitored.

The present invention is completely based on an embedded system. The invention is based on embedded system that is also used in the automation work and wireless communication.

A heart rate meter and a finger print module are implemented which helps to monitor the safety of the car by simply monitoring the driver's heart rate and the finger print which is being registered with a monitoring company.

According to an embodiment of present invention, two microcontrollers are used. One microcontroller (AT89S52) is used to monitor the heart rate measurement and the other one (AT89S52) is interfaced with the finger print scanner. For detecting the heart rate the concepts of photoplethysmography is used. Photoplethysmography is the process of optically estimating the volumetric measurement of an organ. When the heart expands the volume of blood inside the finger tip increases and when the

heart systole the volume of blood inside the finger tip decreases. The resultant pulsing of blood volume inside the finger tip is directly proportional to the heart rate and the pulses is counted for one minute duration with the help of microcontroller to compute the heart rate of the car driver.

The heart rate meter measures the heart rate and provides the heart rate in beats per minute (bpm) and the finger print module scans the finger print of the driver and the whole data is transmitted to the server using a GSM module.

A GSM module is used in the project to monitor the physical status of the driver by sending the calculated heart rate to the prescribed number in a workstation.

A GSM module which is an SIM based module and totally depends on network and need not need to be adjusted as it can transmit data from anywhere it is placed.

In an embodiment of an invention, only a single GSM module is used interfaced with microcontroller so as to transfer the heartbeat reading.

The system has GSM module which can accept any GSM SIM of any telecom company and can transmit the data using the network of the company the SIM belongs to. There is no special station is needed to be set up as the whole data will be received on a cellular phone whose SIM number is feed in the system.

According to an invention the text message is sent in the numeric form that is the heartbeat is sent in numeric forms which even a layman can understand and compare it with the normal heartbeat numeric rate.

The device for detecting and monitoring the physical status of the car driver includes a microcontroller, a heart rate sensor, a liquid crystal display and a GSM module. The heart rate sensor comprises of a pair of IR and a photodiode and an Lm 358 IC

(Operational Amplifier). Whereas the Lm 358 IC is used for amplification and comparison of the current signal outputted from the photodiode. The principle of the heart rate sensor is depended on the concepts of photoplethysmography.

In an embodiment, the heartbeat waveform sensor may be a photoplethysmography sensor or an electrocardiogram sensor.

The amplified and compared signal is in the form of a pulse waveform which is calculated for time duration of one minute to calculate the heart rate per minute by the help of a microcontroller. The output of the microcontroller is transferred onto the liquid crystal display to display the heart rate meter and the message to the driver and also onto the GSM module. The GSM module is used for transmission of the heart rate meter to a prescribed number for monitoring the physical status of the car driver. Figure 1 illustrates the block diagram of the device that is installed in the vehicle for monitoring the physical status of the driver.

The block diagram consists of 4 blocks, a microcontroller block, a heart rate sensor block, a LCD block and a GSM module block. The heart rate sensor block is comprised of a pair of IR, Photo diode and a LM 358 IC (Operational Amplifier). The heart rate sensor takes the input from the finger tip and generates a pulse waveform with the help of the IC.

The outputted waveform of the heart rate sensor block is processed to the microcontroller block which counts the pulse waveform for the time duration of one minute to generate an output in beats per minute.

The GSM module block is coupled with the microcontroller block for transmitting the data to the workstation for monitoring the physical status of the driver.

The present invention includes an integrated microprocessor board which provides pulse rate (heart rate). The microprocessor can also store data. The microprocessor can process the data to display pulse rate. Further, two microprocessors preferably used One microcontroller (at89s52) is used to monitor the heart rate measurement and the other one (at89s52) is interfaced with the finger print scanner.

The display block preferably is a liquid crystal display ("LCD") or other similar display device. Further, the driver's pulse waveform is displayed on the display block. Those skilled in the pertinent art will recognize alternative methods of displaying information on the display block without departing from the scope and spirit of the present invention.

The microprocessors processes the signal generated from the heart rate sensor to generate the pulse waveform information for the driver which is displayed on the display block.

Another aspect of the disclosure provides methods of determining a user's heart rate by using a finger print module. The methods may be characterized by the following operations: (a) challenging the finger tip of driver on said heart rate sensor (b) emitting a current that is amplified by said amplifier (c) generation of a pulse waveform, and said pulse is counted by said microcontroller and (d) transmitted to a prescribed number with help of a GSM module that can be monitored from a workstation (e) providing output to the driver based on one or more of the calculated parameters.

In some embodiments, the heartbeat waveform sensor may be a photoplethysmography sensor or an electrocardiogram sensor.

The system can be placed in such a way that even the driver cannot see the system's location only the driver has to put on the wire which help to sense the heart beat which will never become an irritation for the driver.

The system is required to be installed at any single suitable place of the car where it is safe and sound to work. Advantageously the system is portable and can be installed anywhere in the car as per the manufacturer's or customer's wish. Moreover the system is comparatively less costly as compared to the existing patent and is very much affordable for the customer

While considerable emphasis has been placed herein on the particular features of this invention, it will be appreciated that various modifications can be made, and that many changes can be made in the preferred embodiments without departing from the principles of the invention. These and other modifications in the nature of the invention or the preferred embodiments will be apparent to those skilled in the art from the disclosure herein, whereby it is to be distinctly understood that the foregoing descriptive matter is to be interpreted merely as illustrative of the invention and not as a limitation.

CLAIMS

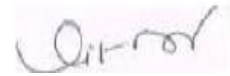
We Claim:

1. A system for monitoring a driver of a vehicle comprising:
a microcontroller;
a heart rate sensor having an infrared diode, a photo diode and an operational amplifier;
a display means; and
a GSM module for transmitting data.
2. The system for monitoring a driver of a vehicle as claimed in claim 1 wherein said microcontroller, said heart rate sensor, said amplifier, said display means and said GSM module are included in onboard diagnostic equipment installed in said vehicle.
3. The system for monitoring a driver of a vehicle as claimed in claim 1 wherein when a finger tip of driver is placed on said heart rate sensor, it emits a current which is amplified by said amplifier and further generates a pulse waveform, and said pulse is counted by said microcontroller and transmitted to a prescribed number with help of a GSM module that can be monitored from a workstation.
4. The heart rate sensor module as claimed in claim 1 comprising an electrocardiogram sensor or photoplethysmography sensor.
5. The system for monitoring a driver of a vehicle as claimed in claim 1 wherein the heart rate waveforms sensor is a photoplethysmographic sensor comprising (i) a pair of IR (ii) a photodiode and (iii) operational amplifier. The heart rate sensor takes the input from the finger tip and generates a pulse waveform with the help of the operational amplifier.

6. A method to monitor a driver, comprising:
 - a) obtaining values of the physiological parameters of the driver from heart rate sensor ;
 - b) transmitting signals indicative of values of the one or more physiological parameters ;
 - c) processing the signals received from the transmitter ; and
 - d) providing one or more indications of results of the processing to the GSM module.
7. The method as claimed in claim 6 comprising steps of:
 - a) challenging the finger tip of driver on said heart rate sensor
 - b) emitting a current that is amplified by said amplifier
 - c) generation of a pulse waveform, and said pulse is counted by said microcontroller and
 - d) transmitted to a prescribed number with help of a GSM module that can be monitored from a workstation.
 - e) providing output to the driver based on one or more of the calculated parameters.
8. The method as claimed in claim 7 wherein calculating a parameter indicative of driver is based upon heart rate.
9. The system for monitoring a driver of a vehicle as claimed in Claim 8 wherein said output of the microcontroller is transferred onto the liquid crystal display to display the heart rate and the message to the driver and also onto the GSM module.

10. The system for monitoring a driver of a vehicle as claimed in claim 1 wherein the GSM module is a SIM based module depends on network and need not need to be adjusted as it can transmit data from anywhere it is placed.

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Vikas Asawat
(INPA -1407) On Behalf of Applicants

Abstract

A system for monitoring a driver of a vehicle that keeps the monitoring means updated about a car at every instance of time by the help of biometric instruments. This system for monitoring a driver of a vehicle comprises a microcontroller, a heart rate sensor having an infrared diode, a photo diode and an operational amplifier, a display means; and a GSM module for transmitting data.

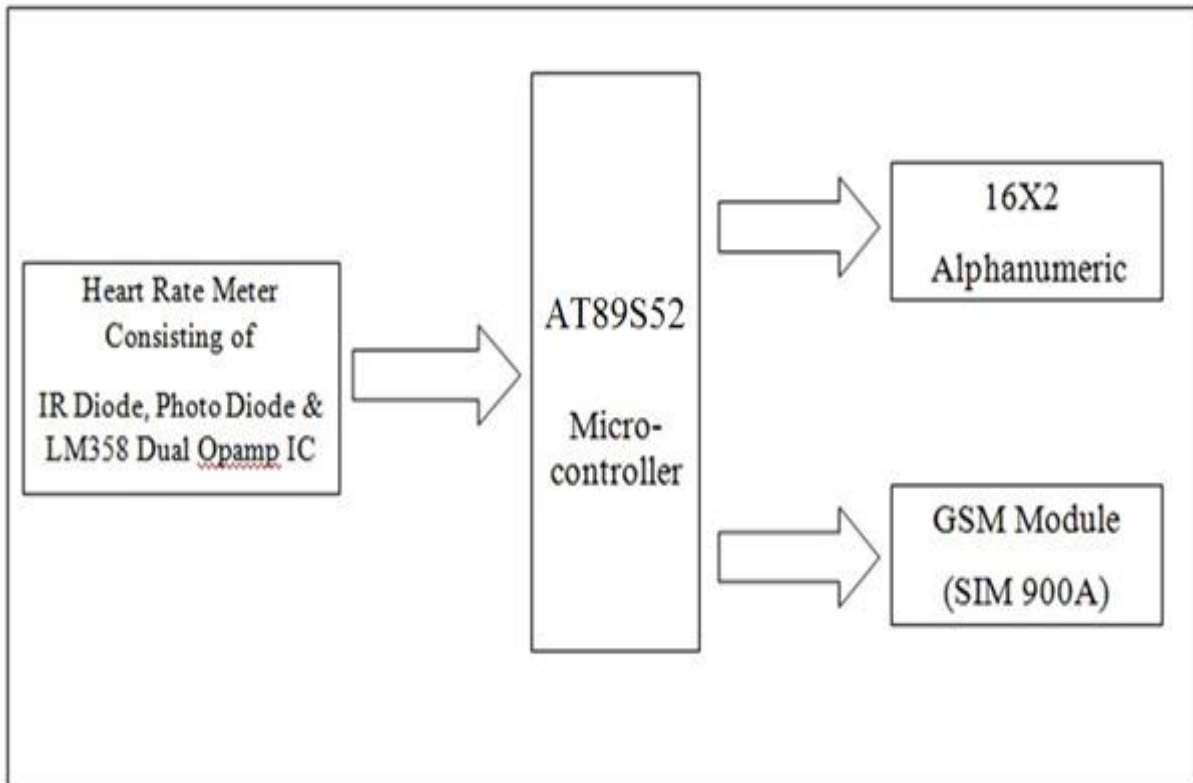


Figure 1

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Vikas Asawat
(INPA -1407) On Behalf of Applicants