Abstract: System and procedure to recognize, notice and identify a deficiency in the eye-motor function coordination of a motor vehicle driver.

The invention relates to a system and procedure for recognizing, noticing and identifying a deficiency in the eye-motor function coordination of a motor vehicle driver. This deficiency may occur due to various reasons, including neurological impairments, fatigue, or distractions. The system and procedure aim to detect such deficiencies in real-time, allowing for immediate corrective actions to be taken by the driver or the vehicle's safety systems.

The system utilizes biometric sensors and data analysis techniques to monitor the driver's eye movements and motor responses. In case of deviations from normal behavior, the system will alert the driver and may also take proactive measures to minimize the risk of accidents. The procedure is designed to be non-intrusive and user-friendly, ensuring that it does not interfere with the driver's control over the vehicle while still providing effective monitoring and protection.

The benefits of this invention are manifold. It not only enhances road safety by preventing accidents caused by driver deficiencies but also promotes proactive safety measures, potentially reducing the need for emergency interventions. Moreover, it supports better training and preparation for drivers, especially those who may be at higher risk of such deficiencies.

In conclusion, the system and procedure for recognizing, noticing and identifying a deficiency in the eye-motor function coordination of a motor vehicle driver represent a significant advancement in road safety technology. They offer a comprehensive solution that combines real-time monitoring with proactive measures, thereby contributing to a safer driving environment.
SYSTEM AND PROCEDURE TO RECOGNIZE, NOTICE AND IDENTIFY A DEFICIENCY IN THE EYE-MOTOR FUNCTION COORDINATION OF A MOTOR VEHICLE DRIVER

SPECIFICATIONS

APPLICATION FIELD

The present invention is related to the transportation industry and the identification of a deficiency in the eye-motor function coordination of a vehicle driver, between the arms that govern the steering wheel and the leg that activates the brake pedal of the vehicle, coordinated in sequential movements with the eyesight, which conforms the central part of the safety system in an emergency maneuver during driving, in the understanding that good but uncoordinated reflexes can be mortal. Particularly, the present invention comprises a system and procedure to capture the position of a driver and simultaneously measures his/her capacity to provide coordinated responses between the steering wheel and the brake pedal when confronted to a special sequence with synchronized intervals of optical emissions that demand a high degree of standard coordination within a limited period. This has the aim of replicating a possible scenario similar to that confronted by a driver on route faced with an unexpected obstacle, and capturing a coordinated eye-motor function aptitude deficiency in the individualized driver before the vehicle is set in motion.

BACKGROUND

With the end of clarifying and unifying the most relevant concepts of this technology, we will define them as follows:

Eye-motor function coordination: Activity of the central nervous system to harmonize in a coherent way the visual perception with corresponding motor responses.

Notice: Direct someone's attention to something, make something noticeable, observe.

Recognize: Carefully examine something or someone to understand their identity, nature and circumstances.

Algorithm: Ordered and finite set of operations to find the solution to a problem.

It has been statistically demonstrated that a relevant amount of accidents is caused by a lack of aptitude of the driver's psychomotor function, reflected in null responses in addition to
failed and extemporaneous responses, which daily causes thousands of irreparable human tragedies mainly originating in the lack of supervision and control by the authority, or irresponsibility, alcohol and drugs associated to driving. It is well known that a driver under the effect of alcohol, drugs, stress or tiredness suffers a relaxation in neurotransmission that causes slower synapses and ultimately translating into eye-motor function deficiencies deriving into a high-risk driving affecting the driver and his/her environment, in the understanding that current vehicle technology is still controlled by complex biological processes of the human body and a driver at 70 km/h travels 19.4 meters in one second, hence an uncoordinated wrong and extemporaneous response can end up in fatal consequences.

Systems based on measuring vital parameters of the driver are already known, as well as others that determine drowsiness, blinking frequency through cameras, and others that measure the attention capacity based on simple stimuli and not compounded stimuli as those required by driving, visual or audible, and diverse sensors for alcohol, lineal and angular movement of the vehicle, which control distances to objects, vehicle acceleration, etc.

An example of the former is described in the US Patent Application US 2007/0267238 describing a method of inhibiting the automatic stop control system of the heat engine of a vehicle in the absence of a driver, with the following abstract description: the invention relates to a method of controlling the stopping and starting of a heat engine of a vehicle, the invention is of the type in which (i) it is necessary for the vehicle to be in an engine stop request phase, and not in pre-defined operating conditions that oppose the stopping of the engine, in order for the engine to be stopped or (ii) it is necessary for the vehicle to be in an engine start request phase, and not in pre-defined operating conditions that oppose the starting of the engine, in order for the engine to be started. The invention is characterized in that, for a given engine stop request phase, the engine can only be stopped or started at most a pre-determined number of times. However, said method does not identify people driving under the effects of tiredness, stress, alcohol or drugs and prevent them to drive.

Another solution is described in the US Patent 5,745,031, which discloses a safety driving system detects a driver's alertness, thereby emitting an alarm depending on the detected alertness. The safety driving system comprises an operation detecting section A, which updates monotonousness \( T \) each time one of the driver-operated device is operated, and subtracts a weight \( n_i \), assigned to the operated device, from a value denoting the monotonousness, a steering detecting section (C) for deriving a steering amount (e.g. SQ), a running position detecting section (A) for detecting a zigzag amount \( (R_n) \) denoting a
deviation of white lines detected based on an image of a road surface, a fuzzy inference section D inferring driver's alertness using membership functions of the sections (A), (B) and (C), and an alerting section F for emitting an alarm in accordance with the detected driver's alertness. The zigzag amount (Rn) may be determined on the basis of images which are taken by a camera and which indicate white lines on the road surface so as to reliably determine the driver's alertness. However, this system lacks driver individualization protocols and measuring protocols for the driver's eye-motor function coordination, and only measures responses to simple stimuli and not complex or compounded stimuli, as is the case with the response required by the technology of the present invention, since this requires, among other parameters, an obligated coordination between arms and legs, according to its protocols.

Actually, no system is known to capture the position of a driver on the driver's seat, establish its lateral limits inside the vehicle and simultaneously ensure in less than 4 seconds a standard and strict evaluation of the driver, including parameters such as compound eye-motor function coordination capacity, lineal orientation, perception of moving objects, and also cognitively conditioning at the reflex level, by way of a regular use, suitable high-performance motor responses in the evaluated driver, in order to be authorized by the system, after an evaluation based on the driver's responses to a special sequence with synchronized intervals of only three optical signals forming a variable random algorithm to be solved, to unblock an immobilization sub-system and/or an acceleration or deceleration sub-system of the vehicle, which comprises several systems and sub-systems, such as said immobilization sub-system and/or the acceleration or deceleration sub-system of the vehicle, the parking brake system of the vehicle, and others, to set the vehicle in motion.

Additionally, drivers are subjected to executing high-performance eye-motor function coordinated movements of the steering wheel and the brake pedal, in scenarios where the dexterity of ability to coordinate operate these vehicle components can be the difference between life and death.

A clear test of the importance of having a suitable eye-motor function coordination when confronting diverse obstacles in different directions, is the fact that diverse types of simulated obstacles are used in driving tests with the aim of suitably training the eye-motor function coordination, specifically applied to the coordination of the operation of the steering wheel in its two directions together with the brake pedal.
An important advantage of the present invention is related to the fact that the disclosed system is specifically directed to the immobilization sub-system and/or the acceleration or deceleration sub-system of the vehicle as a restraining barrier for an unsuited driving, and not to the engine starting system. This is due to the importance of having an operative assisted steering system when executing the protocol to measure the driver's eye-motor function coordination, which facilitates the mechanical angular movement of the steering wheel in real conditions of applied force and execution time, thus avoiding that the protocol to measure the driver's eye-motor function coordination is influenced by possible physical deficiencies of some drivers (e.g., due to age or any physical limitation). The former aspect makes the system of the invention a less invasive and friendlier tool for the driver, which is exclusively focused in measuring his/her real driving capacities and identifying a deficiency in the driver's eye-motor function coordination while avoiding the influence of external factors.

Another advantage of the present invention over other systems is the fact that it allows starting the engine from the beginning, thus avoiding the risk for drivers in extreme temperature conditions such as, for example, temperatures around -20°C. There could be the case in which the driver is not able to suitably respond to the test in which the driver could not be allowed to start the engine in extreme conditions that could even threaten his/her physical integrity or life due to hypothermia or dehydration, given the case.

Furthermore, the present invention is mainly but not exclusively focused on the young driver segment who could be supervised by their tutors in a standard vehicle equipped with this system, which provides a key, or a personalized key different from the normal key, such as a numeric key, an electronic key, a wireless connection key such as a Bluetooth connection key, or a physical lock, that activates this supervision system only when the young driver is driving.
BRIEF DESCRIPTION OF THE INVENTION

The present invention is directed to a system and procedure to detect a possible deficiency in the degree of eye-motor function coordination and also cognitively conditions at a reflex level, by way of a regular use, suitable motor responses of the driver under evaluation. The system is based on the emission of a sequence of optical signals, associated to response sensors and sensors to determine the driver's position inside the vehicle, in order to ensure that only the driver responds and his/her place is not taken by another person after measuring the responses. The system and procedure operates in three steps that associatively interact to block the vehicle driving system if the driver's responses are not suitable. The system an procedure allows detecting in the first place the driver's position inside the vehicle in order to ensure that only the driver's responses are taken into account; subsequently, the system emits sequential optical signals that conform an algorithm and the driver must correctly respond to said signals in such a way that only the coordinated order of said responses in a given time will cause the system to unblock the immobilization sub-system and/or the acceleration or deceleration sub-system of the vehicle. The system comprises sensors that specifically detect the driver's responses to the sequential emission of optical signals.

In this way, the procedure comprises steps that are activated when the system is first powered-up, by means of a key or other embodiment, and each of these steps is associated to a certain group of components, sub-systems, detectors, sensors and emitters of active signals, in order for these steps to operate in separate and consecutive functions. Hence, each step gives rise to the following in a prioritized way, under certain protocols for the individualization and measuring of the eye-motor function coordination of the driver, until unblocking the immobilization sub-system and/or the acceleration or deceleration sub-system of the vehicle.

DESCRIPTION OF THE FIGURES

Figure 1 is a schematic view of an open front door of a conventional vehicle showing the preferred embodiment of the invention, in which the location of a door closing sensor (40) is depicted.

Figure 2 is a schematic view of the instrument panel of the vehicle showing a preferred embodiment of the invention, where emitters of optical individualization signals (3) and an
approval optical signal (7), corresponding to the approval of the protocol of measurement of the driver's eye-motor function coordination, are located.

Figure 3 is a schematic view of the front section of the inside of a vehicle, showing a preferred invention embodiment where the location of door closing sensors (40), driver's seat weight sensors (41) and a photoelectric sensor (42) is depicted.

Figure 4 is a schematic view of the inside of a vehicle, showing the location of a photoelectric sensor (42) and the preferential emission direction of the beam indicated with a segmented line.

Figure 5 is a schematic view of the steering wheel of a conventional vehicle and a section of its steering axle, showing the optional location of a steering wheel turning sensor (8).

Figure 6 is a section view of the instrument panel of a conventional vehicle showing three optical signal emitters (15) optionally located in the front section of the panel.

Figure 7 is a schematic view of the brake pedal of a conventional vehicle showing the optional location of a brake pedal triggering sensor (11).

Figure 8 is a control circuit diagram of a preferred configuration of the system, including the respective components.

DESCRIPTION OF THE INVENTION

As shown in the Figures, the present invention comprises an integral measuring system and procedure able to identify a deficiency in the eye-motor function and lineal orientation capacity of a motor vehicle driver.

The system basically comprises the following elements to fulfill its functions:

An electronic control unit (1),

Optical individualization signals (3), comprising an optical door individualization signal (4), an optical seat individualization signal (5) and an optical photoelectric sensor individualization signal (6),

A steering wheel turning sensor (6), located anywhere on the steering system of the vehicle, even in parts of the steering system that move linearly, such as the steering gear,
A brake pedal triggering sensor (11), located on the brake pedal or anywhere in the brake system,

Optical signal emitters (15), comprising a left optical emitter (12), a central optical emitter (13) and a right optical emitter (14), controlled by the electronic control unit (1).

An activation sub-system with an access key (30),

A sub-system to interrupt the engine operation (31), with an associated approval optical signal (7),

A vehicle immobilization sub-system and/or a vehicle acceleration or deceleration sub-system (32) that allows starting the engine only in a given position (parking or neutral),

A voltage stabilizer or condenser (33),

A door closing sensor (40) that sends a signal (off/on) to the electronic control unit (1) and informs the user through an optical door individualization signal (4),

A driver's seat weight sensor (41) that sends a signal (off/on) to the electronic control unit (1) and informs the user through an optical seat individualization signal (5),

A photoelectric sensor (42), located between the driver and the copilot's seats, that sends a signal (off/on) to the electronic control unit (1) and informs the user through an optical photoelectric sensor individualization signal (6) if the signal emitted by said photoelectric sensor (42) is interrupted, and

Three individualization sensors (43), comprising the door closing sensor (40), the driver's seat weight sensor (41) and the photoelectric sensor (42).

Wherein the brake pedal triggering sensor (11) sends a signal to the electronic control unit (1) when the brake pedal is pressed, which allows responding to the central optical emission (13), physically located in front of the driver between the right optical signal (14) and the left optical signal (12), and detecting the driver's responses based on the patterns of the three optical signals in a random sequence.

Additionally, the present invention discloses a procedure to recognize, notice and identify a deficiency in the eye-motor function coordination of a motor vehicle driver, comprising a protocol to measure the eye-motor function coordination consisting of turning the steering wheel in a determined angle (a) to the left when the left optical emission (12) is turned on;
turning the steering wheel in a determined angle (a) to the right when the right optical emission (14) is turned on; and pressing the brake pedal when the central optical emission (13) is turned on, thus activating the brake pedal triggering sensor (11). One of the characteristics of this eye-motor function coordination measurement protocol is that the driver can respond to said protocol during the emission of the optical signal sequence and the driver can also respond to said protocol immediately after the emission of the optical signal sequence ends, in both cases within a response time T1.

The optical signal sequence comprises optical signal emitters (15), consisting of a left optical emitter (12), a central optical emitter (13) and a right optical emitter (14), which means that there are two time intervals (Ti1, Ti2) between these three emissions and each time interval has its own duration; in a preferred embodiment, they can have the same duration.

In a preferred configuration, Ti1 > Ti2, because a human needs more time to process the first information provided by the first optical signal emission in comparison to the time needed to process the second and third optical signals.

The driver's response time (Tr) is measured by the electronic control unit (1) from the moment when the first optical signal (15) is emitted until the electronic control unit (1) receives the last signal from the response sensors, such as the steering wheel turning sensor (8) and/or the brake pedal triggering sensor (11), and this time is in the range of T1, where T1 is an interval ranging from 0.8 sec to 4 sec.

Hence, T1 ≥ Ti1 + Ti2 + Tr

Furthermore, in another preferred implementation, the optical signal emitters (15) and the individualization optical signals (3) that are emitted in front of the driver and within the driver's field of vision, can come from any visual emission system, such as light bulbs, Image projectors, LED screens, LCD screens, and the like.

The steps comprised by the procedure using the system described above, are the following:

First step: individualization.

From the moment the system is activated, preferably through a key, an immobilization sub-system and/or an acceleration or deceleration sub-system of the vehicle (32) is activated, which comprises a vehicle drive blocking sub-system or a parking brake sub-system (not shown in the figures), only allowing the engine to be started when the gear stick is in a determined position, specifically the parking or neutral position. The electronic control unit (1)
requires in a first step to perform an individualization protocol, comprising the steps of: obtaining the signal from the three sensors; from the door closing sensor (40), the driver's seat weight sensor (41) and the photoelectric sensor (42) that projects a beam between the driver's seat and the copilot's seat, all jointly associated and turning on three respective individualization optical signals (3), preferably from the instrument panel (see Figure 2). In this way, the sensors notify when the required signals have been received in the following way: the door closing sensor (40) sends a signal when the driver side door is closed, in order to notify when this lateral driver limit is blocked; the driver's seat weight sensor (41) sends a signal when the driver is sitting and exerting weight or pressure on the driver's seat; the photoelectric sensor (42) at the border between the driver and the copilot sends a signal indicating that said border is not being trespassed (see Figure 4).

The three individualization sensors (43) are temporized in such a way that, when signals are sent to the electronic control unit (1) indicating that the protocol has been violated, an alerting visible or audible countdown is started for a determined time. When the electronic control unit (1) detects the ending of said countdown, it momentarily interrupts the engine start in order to bring the gear stick to a determined position where the vehicle drive is blocked or null, once the vehicle has stopped. In this way, the vehicle cannot move and the drive can be unblocked only when the protocol of this step is respected and duly fulfilled. Furthermore, the photoelectric sensor beam can be crossed for a determined minimal time without interrupting its signal.

Taking into account that the main goal is to ensure that the driver is not replaced after the driver's eye-motor function coordination measurement protocol is performed, a door individualization optical signal (4) that notifies when the driver's door is closed, another photoelectrical sensor individualization optical signal (6) that notifies when the photoelectric sensor beam is not blocked, and a seat individualization optical signal (5) that notifies when the driver weight is sensed on the driver's seat are provided. Once the electronic control unit (1) gets the respective signals from these individualization sensors (43), the systems consider that the individualization protocol has been suitably performed and finish the first step, turning off or on the individualization signals (3) associated to the three sensors in the panel. When the door closing sensor (40) sends its signal, the door individualization optical signal (4) is turned off; when the driver's seat weight sensor (41) sends its signal, the seat individualization optical signal (5) is turned off, and when the photoelectric sensor (42) sends its signal, the photoelectric sensor individualization optical signal (6) is turned off or on (see Figures 2 and 3).
The trajectory of the photoelectric sensor beam (42) must difficult the replacement of the driver by someone else (see Figure 4). The system keeps the three individualization sensors (43) active since the system is activated until it is deactivated, only through a key or another deactivation mechanism.

Second step: execution of the eye-motor function coordination measurement protocol.

The second step comprises registering coordinated, consecutive and ordered driver responses, which are obtained by the electronic control unit (1) through triggering of a steering wheel turning sensor (8), when the steering wheel is turned to the right or to the left, and a brake pedal triggering sensor (11); all these actions are responses of the driver to the his/her perception of the sequential emission of active optical signals, in the order dictated by the eye-motor function coordination measurement protocol.

Once the individualization optical signals (3) required by the electronic control unit (1) are obtained, this second step is started. In said second step, said electronic control unit (1) emits, preferably through three optical signal emitters, a variable combination of optical signal emissions (15) in determined time interval sequences, wherein the driver must provide a response to the combination of optical signals that conform the eye-motor function coordination measurement protocol in a determined time T1.

The optical signals are preferentially ordered inside the vehicle, in front of the driver and within his/her field of vision, one of them at the left side, another one at the right side and a central signal between both side signals. In this way, the system verifies the eye-motor function capacity for executing a coordinated response in a driver and the eye-motor function coordination measurement protocol is executed in a time T1.

If the electronic control unit (1) verifies that one or both response sensors, i.e. the steering wheel turning sensor (8) or the brake pedal triggering sensor (11), sent a response signal that do not coincide with the eye-motor function coordination measurement protocol (emission order of the emitted sequence), the electronic control unit (1) will emit a different sequence that will require a response according to the eye-motor function coordination measurement protocol within a time interval (T1). Likewise, if the triggering of the steering wheel turning sensor (8) is incomplete and does not comply with the required predetermined steering wheel turning angle (a), the electronic control unit (1) will emit another sequence different from the precedent one that will require to be responded according to the eye-motor function coordination measurement protocol. In this way, the electronic control unit (1) will emit one sequence after another, only until the steering wheel response sensors (8) or the
brake pedal triggering sensor (11) send response sequences to the electronic control unit (1) that are coincident with the optical sequence emitted by the optical signal emitters (15), and also until the steering wheel turning sensor (8) sends to the electronic control unit (1) a signal indicating that the steering wheel has completed the predetermined angle (a), and all this operation will be performed within a predetermined time (T1) for the eye-motor function coordination measurement protocol.

Third step: deactivation of the immobilization sub-system and/or the acceleration or deceleration sub-system of the vehicle.

Instantaneously after finishing the second step and after verifying that the eye-motor function coordination measurement protocol has been correctly executed, the system will emit an active signal, the approval optical signal (7) (see Figure 2), to signal the start of the third step, which comprises the deactivation of the immobilization sub-system and/or the acceleration or deceleration sub-system of the vehicle (32), which can be any conventional system for this function (see Figure 8 as a reference), allowing the access to other gear positions different from the parking or neutral positions, in order for the vehicle to move.

The system makes it difficult to evade and/or alter the execution of the driver's eye-motor function coordination measurement protocol even after unblocking the vehicle drive, since the system is able to recognize in every moment a possible replacement of the evaluated driver because the three individualization sensors (43) are always active, even after unblocking the vehicle drive, always with the aim of preventing a third person to unblock the vehicle drive to subsequently give it unblocked to another driver that has not been previously evaluated by the system and procedure.

As previously mentioned, the system keeps permanently active the three individualization sensors (43), even after unblocking the vehicle drive, all three simultaneously functioning, such that if any of them registers a violation of the individualization protocol for more than approximately 3 seconds, they send individualization protocol violation signals to the electronic control unit (1), which momentarily turns off the engine, after a visual or audible countdown, through an engine operation interruption sub-system (31), without blocking the engine until the vehicle has stopped.

The system will reinitialize and thus will require the gear stick to be shifted to a determined position (parking or neutral) defined for blocking. To unblock the vehicle drive, individualization and driver's eye-coordination measuring protocols must be re-executed until the vehicle drive is unblocked.
This system also allows the driver even to turn off and on the engine without blocking the vehicle drive and not requiring to re-execute the individualization and driver's eye-motor function coordination measurement protocols, as long as the individualization protocol is not violated. This is because the system has a voltage stabilizer or condenser (33) that keeps the voltage stable while the engine is starting to compensate the electrical consumption of the start engine and keeping the electronic control unit (1) in a stable operation.

Furthermore, the system preferably comprises a drive habilitation period, such that even when individualization and driver's eye-coordination measurement protocols have been approved, and with the engine still on, an amount of time can be selectively established after which the system will require to execute again the individualization and driver's eye-motor function coordination measurement protocols until unblocking the vehicle drive. For this, the system activates the engine operation interruption sub-system (31) or optionally a controlled velocity system that brings the vehicle to a minimal or null velocity, requiring the driver to shift the gear stick to a determined position (parking or neutral) and requiring him/her to execute again the individualization and eye-motor function coordination measurement protocols. In this case, the system will give a warning with a countdown and an optical or audible signal to notify the driver that the engine operation interruption sub-system (31) will be activated within a time interval programmed by the driver or user.

The time interval programmed by the driver or user for the activation of the engine operation interruption sub-system (31) ranges from 15 minutes to 5 hours, and will be determined by the driver or user and cyclically activated.

The countdown that warns the driver will range from 5 minutes to 30 minutes.

By way of an example, a case could arise in which a driver drives while consuming alcohol or drugs, or is under stress, or has been driving for an excessive time that puts his/her physical integrity or the physical integrity of other passengers at risk (as e.g. in bus or truck drivers), and therefore the engine operation interruption sub-system (31) will be periodically activated within the interval programmed by the driver or user, after a warning countdown, in such a way as to constantly measure the driver's eye-motor function coordination in long routes.

In another preferable implementation, in the case when the driver is unable to succeed performing the individualization and driver's eye-motor function coordination measurement protocols, an automatic driving sub-system will be activated, in which the vehicle is self-driven to park automatically, which implies the deactivation of the unblocking system of the immobilization sub-system and/or the acceleration or deceleration sub-system of the vehicle.
According to Figures 2, 3 and 8, the present invention discloses a system that recognizes, notices and identifies a deficiency in the eye-motor function coordination of a motor vehicle driver, comprising:

- an electronic control unit (1) that controls the system and comprises a controller of times T1, T2, T3 and T4, and also controls the procedure that recognizes, notices and identify a deficiency in the eye-motor function coordination;

- a steering wheel turning sensor (8) that sends information about the turning angle (a) to the electronic control unit (1);

- a brake pedal triggering sensor (11) that sends information to the electronic control unit (1) regarding the brake pedal triggering;

- an activation sub-system with an access key (30) that is connected to the electronic control unit (1);

- an engine operation interruption sub-system (31) that is connected to the electronic control unit (1);

- a vehicle immobilization sub-system and/or a vehicle acceleration or deceleration sub-system (32) that allows starting the engine only in a given position (parking or neutral) that is connected to the electronic control unit (1);

- a voltage stabilizer or condenser (33) that is connected to the electronic control unit (1);

- a door closing sensor (40) that sends a signal (off/on) to the electronic control unit (1) and informs the user through an optical door individualization signal (4);

- a driver's seat weight sensor (41) that sends a signal (off/on) to the electronic control unit (1) and informs the user through an optical seat individualization signal (5);

- a photoelectric sensor (42) that sends a signal (off/on) to the electronic control unit (1) and informs the user through an optical photoelectric sensor individualization signal (6).
optical signal emitters (15), comprising a left optical emitter (12), a central optical emitter (13) and a right optical emitter (14), controlled by the electronic control unit (1), and

three individualization sensors (43).

The system further comprises: individualization optical signals (3) comprising a door individualization optical signal (4), a seat individualization optical signal (5) and a photoelectric sensor individualization optical signal (6), and an approval optical signal (7) corresponding to the approval of the driver's eye-motor function coordination measurement protocol.

In another preferred implementation, the optical emissions are emitted by the optical signal emitters (15) and are emitted in front of the driver and within the driver's field of vision, coming from a visual emission system, such as light bulbs, a LED bulb, a projector, a LED, plasma or LCD screen.

Additionally, the present invention discloses a procedure to recognize, notice and identify a deficiency in the eye-motor function coordination of a motor vehicle driver, comprising the following steps:

a) entering into a vehicle;

b) activating a vehicle start system and starting the engine, which activates an electronic control unit (1) and a vehicle immobilization sub-system and/or a vehicle acceleration or deceleration sub-system (32), which allow starting the engine when the gear stick is in the parking or neutral position;

c) executing an individualization protocol that comprises:

obtaining the signal from the three sensors; all the three sensors, the door closing sensor (40) located at the driver's door, the driver's seat weight sensor (41) located at the driver's seat and the photoelectric sensor (42) that projects a beam between the driver's seat and the copilot's seat, being jointly associated and each having its respective activation or deactivation individualization optical signals (3) located within the field of vision of the driver;

receiving at the electronic control unit (1) the information provided by the door closing sensor (40) indicating that the driver's door is closed, the information provided by the driver's seat weight sensor (41) indicating that weight is detected on the driver's seat, and the information provided by the photoelectric sensor (42)
indicating that the beam is uninterrupted; said three individualization sensors (43) being always active, and when the electronic control unit (1) receives at least one variation in the signal lectures of the door closing sensor (40) and/or the driver's seat weight sensor (41) and/or the photoelectric sensor (42), said individualization protocol has to be executed again.

d) fulfilling an eye-motor function coordination measurement protocol, which comprises:

observing the sequential random order of the optical signal emissions (15), which conform an optical sequence emitted in front of the driver and within the driver's field of view, and imitating the sequential random order of the optical signal emissions (15) in the following way:

  turning a steering wheel to the left in a determined angle (a) when the left optical emission (12) is turned on; turning the steering wheel in a determined angle (a) to the right when the right optical emission (14) is turned on; and pressing the brake pedal when the central optical emission (13) is turned on, wherein the driver must execute the eye-motor function coordination measurement protocol in a determined time T1, and the steering wheel turn angle (a) is informed to the electronic control unit (1) through a steering wheel turning sensor (8) and the triggering of the brake pedal is informed to the electronic control unit (1) through the brake pedal triggering sensor (11).

e) verifying, by means of the electronic control unit (1), that the individualization protocol and the eye-motor function coordination measurement protocol were correctly executed by the driver;

f) deactivating, by means of the electronic control unit (1), the vehicle immobilization sub-system and/or the vehicle acceleration or deceleration sub-system (32), allowing the vehicle to move.

In a preferred configuration, the range of time T1 is a time interval ranging from 0.8 sec to 4 sec.

In another preferred configuration, the amount of opportunities for the driver to correctly execute the eye-motor function coordination measurement protocol is predetermined, where the amount of opportunities is predetermined through a user interface and the amount of opportunities is at least 2.
In case the driver does not correctly fulfill the eye-motor function coordination measurement protocol in the predetermined amount of opportunities and within the time T1, the electronic control unit (1) ceases to emit said protocol and the vehicle remains in standby for a predetermined standby period, which can be at least 5 minutes.

In another preferred implementation the user can configure a periodic and cyclic emission of the eye-motor function coordination measurement protocol wherein the period of cyclic emission of the eye-motor function coordination measurement protocol lasts at least 15 minutes.

In another preferred configuration, a warning countdown will be activated with a predetermined duration to activate the engine operation interruption sub-system (31), when the individualization protocol is violated in route or when the predetermined period for the cyclic emission of the eye-motor function measurement protocol comes to an end, wherein said warning countdown with a predetermined duration lasts at least 1 minute.

The steering wheel turning angle (a) ranges from 5° to 270°.

In another preferred configuration, a warning countdown with a predetermined duration will be activated to activate the engine operation interruption sub-system (31) in case the driver violates the individualization protocol when opening the door for more than a predetermined time T2.

In another preferred configuration, a warning countdown with a predetermined duration will be activated to activate the engine operation interruption sub-system (31) in case the driver violates the individualization protocol when not exerting weight pressure on the driver's seat for more than a predetermined time T3.

In another preferred configuration, a warning countdown with a predetermined duration will be activated to activate the engine operation interruption sub-system (31) in case the driver violates the individualization protocol when interrupting the trajectory of the beam projected by the photoelectric sensor (42) for more than a determined time T4, wherein each of the determined times T2, T3 and T4 have a duration of at most 3 seconds.

In another preferred configuration, a warning countdown will be activated with a predetermined duration to activate a controlled velocity sub-system, when the individualization protocol is violated in route or when the predetermined period for the cyclic emission of the eye-motor function measurement protocol comes to an end.
In another preferred configuration, an automatic parking sub-system will be activated and once the vehicle is parked the eye-motor function coordination measurement protocol will be executed in a safe way.

Furthermore, said individualization and eye-motor function coordination measurement protocols are configured or activated through a user interface that is accessed through an activation sub-system with an access key (30).
CLAIMS

1. System to recognize, notice and identify a deficiency in the eye-motor function coordination of a motor vehicle driver, said system comprising:

   an electronic control unit (1) that controls the system and comprises a controller of times T1, T2, T3 and T4, and also controls the procedure that recognizes, notices and identify a deficiency in the eye-motor function coordination;

   a steering wheel turning sensor (8) that sends information about the turning angle (a) to the electronic control unit (1);

   a brake pedal triggering sensor (11) that sends information to the electronic control unit (1) regarding the brake pedal triggering;

   an activation sub-system with an access key (30) that is connected to the electronic control unit (1);

   an engine operation interruption sub-system (31) that is connected to the electronic control unit (1);

   a vehicle immobilization sub-system and/or a vehicle acceleration or deceleration sub-system (32) that allows starting the engine only in a given position (parking or neutral), connected to the electronic control unit (1);

   a voltage stabilizer or condenser (33) that is connected to the electronic control unit (1);

   a door closing sensor (40) that sends a signal (off/on) to the electronic control unit (1) and informs the user through an optical door individualization signal (4);

   a driver's seat weight sensor (41) that sends a signal (off/on) to the electronic control unit (1) and informs the user through an optical seat individualization signal (5);

   a photoelectric sensor (42) that sends a signal (off/on) to the electronic control unit (1) and informs the user through an optical photoelectric sensor individualization signal (6),
optical signal emitters (15), comprising a left optical emitter (12), a central optical emitter (13) and a right optical emitter (14), controlled by the electronic control unit (1); and

three individualization sensors (43), comprising the door closing sensor (40), the driver's seat weight sensor (41) and the photoelectric sensor (42).

2. System to recognize, notice and identify a deficiency in the eye-motor function coordination according to claim 1, said system comprising: individualization optical signals (3) comprising a door individualization optical signal (4), a seat individualization optical signal (5) and a photoelectric sensor individualization optical signal (6), and an approval optical signal (7) corresponding to the approval of a driver's eye-motor function coordination measurement protocol.

3. System to recognize, notice and identify a deficiency in the eye-motor function coordination according to claim 1, wherein the optical emissions are emitted by the optical signal emitters (15) and are emitted in front of the driver and within the driver's field of vision, coming from a visual emission system, such as light bulbs, LED bulbs, a projector, a LED, plasma or LCD screen.

4. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination of a motor vehicle driver, said procedure comprising the following steps:
   a) entering into a vehicle;
   b) activating a vehicle start system and starting the engine, which activates an electronic control unit (1) and a vehicle immobilization sub-system and/or a vehicle acceleration or deceleration sub-system (32), which allow starting the engine when the gear stick is in the parking or neutral position;
   c) executing an individualization protocol that comprises:

      obtaining the signal from the three sensors; all the three sensors, the door closing sensor (40) located at the driver's door, the driver's seat weight sensor (41) located at the driver's seat and the photoelectric sensor (42) that projects a beam between the driver's seat and the copilot's seat, being jointly associated and each having its respective activation or deactivation individualization optical signals (3) located within the field of vision of the driver;
receiving at the electronic control unit (1) the information provided by the door closing sensor (40) indicating that the driver's door is closed, the information provided by the driver's seat weight sensor (41) indicating that weight is detected on the driver's seat, and the information provided by the photoelectric sensor (42) indicating that the beam is uninterrupted; said three individualization sensors (43) being always active, and when the electronic control unit (1) receives at least one variation in the signal lectures of the door closing sensor (40) and/or the driver's seat weight sensor (41) and/or the photoelectric sensor (42), said individualization protocol has to be executed again.

d) fulfilling an eye-motor function coordination measurement protocol, which comprises:

observing the sequential random order of the optical signal emissions (15), which conform an optical sequence emitted in front of the driver and within the driver's field of view, and imitating the sequential random order of the optical signal emissions (15) in the following way:

turning a steering wheel to the left in a determined angle (a) when the left optical emission (12) is turned on; turning the steering wheel in a determined angle (a) to the right when the right optical emission (14) is turned on; and pressing the brake pedal when the central optical emission (13) is turned on, wherein the driver must execute the eye-motor function coordination measurement protocol in a determined time T1, and the steering wheel turn angle (a) is informed to the electronic control unit (1) through a steering wheel turning sensor (8) and the triggering of the brake pedal is informed to the electronic control unit (1) through the brake pedal triggering sensor (11).

e) verifying, by means of the electronic control unit (1), that the individualization protocol and the eye-motor function coordination measurement protocol were correctly executed by the driver; and

f) deactivating, by means of the electronic control unit (1), the vehicle immobilization sub-system and/or the vehicle acceleration or deceleration sub-system (32), allowing the vehicle to move.

5. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claim 4, wherein the time interval T1 ranges from 0.8 sec to 4 sec.
6. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claim 4, wherein the amount of opportunities for the driver to correctly execute the eye-motor function coordination measurement protocol is predetermined.

7. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claim 6, wherein the amount of opportunities is predetermined through a user interface.

8. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claim 7, wherein the amount of predetermined opportunities is at least 2.

9. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claim 4, 5 and 6, wherein in case the driver does not correctly fulfill the eye-motor function coordination measurement protocol in the predetermined amount of opportunities and within the time $T_1$, the electronic control unit (1) ceases to emit said protocol and the vehicle remains in standby for a predetermined standby period, which can be at least 5 minutes.

10. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claim 9, wherein the predetermined standby time is at least 5 minutes.

11. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claim 4, wherein the user configures the eye-motor function coordination measurement protocol to be periodically and cyclically emitted.

12. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claim 4, wherein the cyclic emission period of the eye-motor function coordination measurement protocol is at least 15 minutes.

13. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claims 4 and 11, wherein a warning countdown with a predetermined duration will be activated to activate the engine operation interruption sub-
system (31), when the individualization protocol is violated in route or when the predetermined period for the cyclic emission of the eye-motor function measurement protocol comes to an end.

14. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claim 13, wherein the warning countdown with a predetermined duration is at least 1 minute.

15. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claim 4, wherein the steering wheel turning angle (a) ranges from $5^\circ$ to $270^\circ$.

16. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claims 4 and 13, wherein a warning countdown with a predetermined duration will be activated to activate the engine operation interruption subsystem (31), in case the driver violates the individualization protocol when opening the door for more than a predetermined time T2.

17. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claims 4 and 13, wherein a warning countdown with a predetermined duration will be activated to activate the engine operation interruption subsystem (31), in case the driver violates the individualization protocol when not exerting weight pressure on the driver's seat for more than a predetermined time T3.

18. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claims 4 and 13, wherein a warning countdown with a predetermined duration will be activated to activate the engine operation interruption subsystem (31), in case the driver violates the individualization protocol when interrupting the trajectory of the beam projected by the photoelectric sensor (42) for more than a determined time T4.

19. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claims 4 and 13, wherein each of the determined times T2, T3 and T4 have a duration of at most 3 seconds.
20. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claims 4 and 11, wherein a warning countdown with a predetermined duration will be activated to activate a controlled velocity sub-system, when the individualization protocol is violated in route or when the predetermined period for the cyclic emission of the eye-motor function measurement protocol comes to an end.

21. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claim 20, wherein an automatic parking sub-system will be activated and once the vehicle is parked the eye-motor function coordination measurement protocol will be executed in a safe way.

22. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claim 4, wherein said individualization and eye-motor function coordination measurement protocols are configured or activated through a user interface.

23. Procedure to recognize, notice and identify a deficiency in the eye-motor function coordination according to claim 4, wherein said user interface is accessed through an activation sub-system with an access key (30)
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A61B 3/113; B60N 20/08; G01C 21/06 (2014.01)
USPC - 351/209

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8)-A61B 3/113; B60N 20/08; G01C 21/06 (2014.01)
USPC-351/209

Electronic data base consulted during the international search (name of data base and, when practicable, search terms used)


C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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<td>Y</td>
<td>US 2013/0066523 A1 (IWAMOTO, K et al.) March 14, 2013, paragraph [0170]</td>
<td>2-1</td>
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Further documents are listed in the continuation of Box C.

D. Search report

Date of the actual completion of the international search: 04 February 2014 (04/02/2014)

E. Authorizing authority

Name and mailing address of the ISA/US

P.O. Box 1450, Alexandria, Virginia 22313-1450

Fax number: 571-273-3200

Form PCT/ISA/210 (second sheet) (July 2009)
**INTERNATIONAL SEARCH REPORT.**

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<td>2. □ Claims Nos.: because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:</td>
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<td>3. ☑ Claims Nos.: 16-19 because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).</td>
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<td>2. □ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.</td>
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<td>3. □ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:</td>
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<tr>
<td>4. □ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:</td>
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**Remark on Protest**

- The additional search fees were accompanied by the applicant’s protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant’s protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (July 2009)