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DESCRIPTION

TECHNICAL FIELD

[0001] The disclosure herein generally relate to tracking face of a user, and more particularly, a system and method for face position tracking and alerting a driver.

BACKGROUND

[0002] Determining the alertness of a user is one of the areas for research. One of the examples for determining the alertness is a driver in a vehicle using. Fatalities have occurred as a result of car accidents related to driver inattention, such as fatigue and lack of sleep. Physiological feature-based approaches are intrusive because the measuring equipment must be attached to the driver. Physiological feature based approaches utilize visual technologies to determine the alertness of the user. Thus, physiological feature-based approaches have recently become preferred because of their non-intrusive nature.

[0003] The existing models of driver alertness monitoring (DAM) system relies on detection of frontal face using a camera that is placed in front of the driver. Most of the existing methods use CAMSHIFT algorithms that rely on the skin color. Therefore, tracking is efficient in day light. The other problem with optical flow tracking is the key points on the face always tends to be missed if there is jerk in driving. The optical flow tracking is not so reliable if someone rubs hand over the face. The key points in a face are dragged by the hand showing wrong alert. Jeong Mira et al.: "Facial landmark detection based on an ensemble of local weighted regressors during real driving situation" relates to a novel method for facial landmark detection (FLD) based on an ensemble of local weighted regressors and a global face shape model under real driving situations. Unlike other FLD approaches, the method proposed in this study first detects the nose region instead of a face-bounding box as a reference point for estimating the offset from a landmark and a reference point. Next, a weighted random forest regressor (WRFR) is used for designing a regressor that maintains the generality while utilizing a small number of decision trees. During the training period, some of the trees having low accuracy are removed and the remaining trees of the WRFR have different weights according to their regression accuracy. As a global face shape model, the authors use the spatial relationship between three landmarks to identify erroneous estimates of the local regressors and provide valid alternatives. Using the unified framework of the proposed FLD, their algorithm is robust to facial expressions and partial occlusions caused by a subject's hair or sunglasses. For their experiment, using a near- infrared camera, the authors constructed a benchmark dataset for FLD under real driving situations, which they call the Face Alignment Dataset used In Driving (FADID). The proposed algorithm was successfully applied to various driving sequences in FADID, and the results show that its FLD detection performance is better than that of other state-of-the-art methods.

[0004] US 6 049 747 A discloses a driver monitoring system, a pattern projecting device consisting of two fiber gratings stacked orthogonally which receive light from a light source projects a pattern of bright spots on a face of a driver. A image pick-up device picks up the pattern of bright spots to provide an image of the face. A data processing device processes the image, samples the driver's face to acquire three-dimensional position data at sampling points and processing the data thus acquired to provide inclinations of the face of the driver in vertical, horizontal and oblique directions. A decision device decides whether or not the driver is in a dangerous state in accordance with the inclinations of the face obtained. A warning device warns the driver against his dangerous state. The pattern light projecting device and pick-up device are integrated to each other and installed on a steering column on a vehicle. Thus, the driver monitoring system can assure performance, reliability and safety without hindering the driver in view of its installation on the vehicle.

SUMMARY

[0005] Embodiments of the present disclosure present technological improvements as solutions to one or more of the above-mentioned technical problems recognized by the inventors in conventional systems. In one embodiment, a method for face position tracking and alerting a driver is disclosed. The method comprises the features of claim 1.

[0006] In another embodiment, a system for face position tracking and alerting a driver as defined in claim 8 is disclosed.

[0007] In yet another aspect, a non-transitory computer-readable medium for face position tracking and alerting a driver according to claim 15 is disclosed.

[0008] It is to be understood that both the foregoing general description and the following detailed description are explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The accompanying drawings, which are incorporated in and constitute a part of this disclosure, illustrate exemplary embodiments and, together with the description, serve to explain the disclosed principles:

FIG. 1 illustrates a system for face position tracking and alerting user, according to some embodiments of the present disclosure.

FIG. 2 is an example of tree based representation of deformable pattern model (DPM), according to some embodiments of the present subject matter;

FIG. 3 (FIG 3(a) and FIG 3(b)) is an example of the dual flexible spider model of a driver in the car, according to some embodiments of the present subject matter;

FIG. 4 (FIG 4(a) and FIG 4(b)) is an example of user interface for alerting the user, according to some embodiments of the present subject matter; and

FIG. 5 (FIG 5(a) and FIG 5(b)) is a flow chart illustrating a method for face position tracking and alerting the user, according to some embodiments of the present subject matter.

DETAILED DESCRIPTION OF EMBODIMENTS

[0010] Exemplary embodiments are described with reference to the accompanying drawings. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. Wherever convenient, the same reference numbers are used throughout the drawings to refer to the same or like parts. While examples and features of disclosed principles are described herein, modifications, adaptations, and other implementations are possible without departing from scope of the disclosed embodiments

[0011] The manner in which the described system is implemented for face position tracking and alerting the user has been explained in detail with respect to the following figure(s). While aspects of the described system can be implemented in any number of different computing systems, transmission environments, and/or configurations, the embodiments are described in the context of the following exemplary system.

[0012] FIG. 1 schematically illustrates a system 100 for face position tracking of a user and alerting the user, according to an embodiment of the present disclosure. As shown in FIG. 1, the system 100 includes one or more processor(s) 102 and a memory 104 communicatively coupled to each other. The memory 104 includes a face tracking module 106 that tracks the face position of the user and alert the user. The system 100 also includes interface(s) 108. Although FIG. 1 shows example components of the system 100, in other implementations, the system 100 may contain fewer components, additional components, different components, or differently arranged components than depicted in FIG. 1.

[0013] The processor(s) 102 and the memory 104 may be communicatively coupled by a system bus. The processor(s) 102 may include circuitry implementing, among others, audio and logic functions associated with the communication. The processor 102 may include, among other things, a clock, an arithmetic logic unit (ALU) and logic gates configured to support operation of the processor(s) 102. The processor(s) 102 can be a single processing unit or a number of units, all of which include multiple computing units. The processor(s) 102 may be implemented as one or more microprocessors, microcomputers, microcontrollers, digital signal processors, central processing units, state machines, logic circuitries, and/or any devices that manipulate signals based on operational instructions. Among other capabilities, the processor(s) 102 is configured to fetch and execute computer-readable instructions and data stored in the memory 104.

[0014] The functions of the various elements shown in the figure, including any functional blocks labeled as "processor(s)", may be provided through the use of dedicated hardware as well as hardware capable of executing software in association with appropriate software. When provided by a processor, the functions may be provided by a single dedicated processor, by a single shared processor, or by a plurality of individual processors, some of which may be shared. Moreover, explicit use of the term "processor" should not be construed to refer exclusively to hardware capable of executing software, and may implicitly include, without limitation, digital signal processor (DSP) hardware, network processor, application specific integrated circuit (ASIC), field programmable gate array (FPGA), read only memory (ROM) for storing software, random access memory (RAM), and non-volatile storage. Other hardware, conventional, and/or custom, may also be included.

[0015] The interface(s) 108 may include a variety of software and hardware interfaces, for example, interfaces for peripheral device(s), such as a keyboard, a mouse, an external memory, and a printer. The interface(s) 108 can facilitate multiple communications within a wide variety of networks and protocol types, including wired networks, for example, local area network (LAN), cable, etc., and wireless networks, such as Wireless LAN (WLAN), cellular, or satellite. For the purpose, the interface(s) 108 may include one or more ports for connecting the system 100 to other network devices.

[0016] The memory 104 may include any computer-readable medium known in the art including, for example, volatile memory, such as static random access memory (SRAM) and dynamic random access memory (DRAM), and/or non-volatile memory, such as read only memory (ROM), erasable programmable ROM, flash memories, hard disks, optical disks, and magnetic tapes. The memory 104, may store any number of pieces of information, and data, used by the system 100 to track face positioning of user's face and alerting the user. The memory 104 may be configured to store information, data, applications, instructions or the like for system 100 to carry out various functions in accordance with various example embodiments. Additionally or alternatively, the memory 104 may be configured to store instructions which when executed by the processor 102 causes the system 100 to behave in a manner as described in various embodiments. The memory 104 includes the face tracking module 106 and other modules. The face tracking module 106 include routines, programs, objects, components, data structures, etc., which perform particular tasks or implement particular abstract data types.

[0017] In an embodiment, a method for tracking face position of a user and alerting the user in case the face is diverted from an original position is disclosed. The face tracking module 106 captures one or more images using a camera. The camera is positioned at an angle from a user's face. For example, in a car, to track face position of a driver, a monocular camera can be placed to A-pillar of the car. Therefore, the monocular camera captures the images from a side angle of the driver instead of capturing images from the front angle.

[0018] Subsequently, if there are more than one person in the one or more images, one or more faces are identified from the one or more images captured and a user's face is identified based on space occupied in the one or more images. The face occupying more space is considered as the user's face for tracking face position of the user. In this method the one or more faces are detected using the haar cascade classifier algorithm and a confidence score is given to bigger face. For example, in the case of determining the face position of the driver in a car the space occupied is more because the driver will be closer to the camera than other faces in the car. The user's face is stored as a reference face for future comparison.

[0019] In an embodiment, the user's face is divided into two regions, namely a first region and a second region. For example, the user's face can be divided into a left region and a right region. The face tracking module 106 further identifies one or more corner points from the first region and the second region of the user's face. The one or more corner points are identified by finding a rough position of the user's face using a face detector. The one or more corner points are determined based on intensity of light falling on the user's face.

[0020] In an embodiment, the face tracking module 106 uses deformable part model (DPM) on low resolution face to refine the position of the user's face detected. Subsequently finding features sparsely on the high resolution image using different DPM in required region of interest of the user's face.

[0021] FIG. 2 is an example of tree based representation of deformable pattern model (DPM), according to some embodiments of the present subject matter. FIG. 2 is an example of tree based unidirectional representation of DPM, where one or more nodes of the tree represent the one or more corner points depicting the local features and the edges connecting them gives the relative position with respect to neighboring corner points.

[0022] The tree graph is computed based on the equation, tree graph G= (V, E)

[0023] The example contains seven vertices S1 to S7 are the one or more corner points and E_{12}, E_{25}, E_{43}, E_{35}, E_{75}, E_{65} are the six edges connecting the vertices S1 to S7.

$$F(I, s) = \sum_{i-v} q_i(I, s_i) + \sum_{(i,j)-E} g(s_i, s_j)$$

[0024] Where first term corresponds to the match between position of the key point si and image I. It represents the quality of fit of one or more corner points. Second term corresponds to deformation cost determining the relative position of the two corner points.

[0025] In an embodiment, the face tracking module 106 creates a centroid in each of the first region and the second region. The centroid in each of the first region and the second region are joined with the respective one or more corner points using a plurality of virtual lines to create a dual flexible spider model. FIG. 3 (FIG 3a and FIG 3b) is an example of the dual flexible spider model of a driver in the car, according to some embodiments of the present subject matter.

[0026] In an embodiment, a method for creating a plurality of virtual lines dense in the dual flexible spider model is disclosed. If the user's face is attentive for a pre-defined time period, one or more corner points are increased. The face tracking module 106 increases one or more corner points by equalizing face region and applying a laplacian filter to enhance edges. The increased edges increase the one or more corner points. The method further joins the centroid with the increased respective one or more corner points to create the plurality of virtual lines dense in the dual flexible spider model.

[0027] In an embodiment, when the position of the user's face changes from one position to other position, new corner points are created.

[0028] In an embodiment, a reset logic is added to create one or more new corner points in continuous tracking if any of the following conditions are satisfied The conditions on which a reset logic is utilized are:

1. (i) the user's face is not visible or (ii) the one or more virtual lines are not handling the face due to fast movement or (iii) deviation of the user's face is greater than a threshold.

[0029] The one or more new corner points are location coordinates of the corner points of the user's face. Therefore, the one or more new corner points are subjected to optical flow frame pair wise.

[0030] The face tracking module 106 calculates angle and magnitude of the flow vectors obtained from the optical flow for each transition between each pair of frames. The face tracking module 106 further describes the continuous head motion based on the position of the one or more new corner points. The flow vectors are very fragile and disperse with small variation in motion such as jerk or inadvertent motion such as driver hand movements while driving. The flow vectors are divided into three types.

[0031] Based on the angle and magnitude of the one or more flow vector points, the one or more flow vectors are classified into three groups a)Valid Motion Vectors b)Invalid Motion Vectors and c)Static Vectors.

[0032] One or more valid motion vectors are the flow vectors if the magnitude of the one or more flow vectors is within a predefined magnitude or the plurality of virtual lines are moving in same direction or exhibit homogeneous scaling or there is co-presence of vectors. One or more invalid motion vectors are the one or more flow vectors if the magnitude of the one or more flow vectors is greater than the predefined magnitude or the plurality of virtual lines are not moving in same direction or do not exhibit homogeneous scaling or there is no co-presence of vectors and one or more static motion vectors are the one or more flow vectors if the magnitude of the one or more flow vectors is constant.

[0033] In an embodiment, the face tracking module 106 considers one or more valid motion vectors for further process. The invalid motion vectors and static motion vectors are not considered for tracking and giving an alarm to the user.

[0034] In an embodiment, different scenarios for giving an alert to the user are disclosed. In an embodiment, the face tracking module 106 considers the dual spider model of the valid motion vectors. The angle and magnitude caused due to change in the position of the virtual lines for the valid motion vectors is considered. If the angle and magnitude of the virtual lines is greater than the threshold, then an alarm is given. However, if the angle and magnitude of the virtual lines of the dual spider is less than the threshold then an alarm is not given.

[0035] In another embodiment, an alarm is given when the user's face is not visible.

[0036] In an embodiment, the face tracking module 106 captures the user's face and matches the user's face with the reference face. If the user's face is not matching with the reference face, the user is not attentive and a first alert is given to the user. A second alert is given if the user is not matching with the reference face after the first alert.

[0037] FIG. 4 is an example of user interface for alerting the user, according to some embodiments of the present subject matter. FIG. 4(a) is an example of user interface when the user is alert. A threshold for magnitude and angle is provided by the user. The angle and magnitude is within the threshold as the user is alert. An emoticon in FIG. 4(a) is indicating that the user is alert. In FIG. 4(b), the user is not alert. The angle and magnitude of flow vectors in the FIG. 4(b) has reached the threshold values. The emoticon in the FIG 4(b) is indicating that the user is not visible.

[0038] In an embodiment, if the user's face is attentive for the predefined time period, the magnitude and the phase value is reset to avoid a false alert due to accumulation of noisy movements.

[0039] In an embodiment, the situations for false alerts are considered. The false alerts are caused if the driver is moving head such that he is not feeling sleepy but just not attentive, then there is (small) valid motion flow vector magnitude additions and the magnitude of flow vectors can sometimes be greater than threshold giving false alarms.

[0040] In order to address the false alarm problem, the face tracking module 106 comprises a periodic timer co-relator. The periodic timer co-relator frequently checks if the reference face is matching with the user's face that is created with the one or more new corner points. If the face is matched at predefined intervals of time then it means that the user is looking and the magnitudes of VM Vectors can be reset to remove invalid vector additions to eliminate false alarms. If the face is not matched properly after predefined intervals, then one or more new corner points are considered.

[0041] Similarly if the user falls asleep in the same position without head movement, the system 100 will not give the alarm. Therefore, to determine the alertness of the user when there is no head movement, the face tracking module 106 detects the eyes of the driver. If the eyes are detected then no alarm is raised and if the eyes of the user are detected, then alarm is raised and one or more new corner points are considered.

[0042] FIG. 5 ((FIG 5(a) and FIG 5(b)) is a flow chart illustrating a method for face position tracking of a user and alerting the user, according to some embodiments of the present subject matter. At block 502, one or more images are captured through a camera. At block 504, a user's face is identified from one or more face identified in the one or more images. At block 506, the user's face is divided into a first region and second region and one or more corner points are identified from the first region and the second region. At block 508, a centroid in each of the first region and the second region is created and joining the centroid with one or more corner points using virtual lines to create a dual flexible spider model. At block 510, a plurality of virtual lines are created dense in the dual flexible spider model. At block 512, variations in the dual flexible spider model are tracked by computing one or more flow vectors. At block 514, one or more new corner points are created and one or more flow vectors are created by subjecting the one or more new corner points to optical flow frame. At block 516, one or more valid motion vectors, one or more invalid motion vectors and one or more static vectors are determined. At block 518, the user is given an alert if the angle and magnitude of the valid motion vectors is greater than threshold.

[0043] The hardware device can be any kind of device which can be programmed including e.g. any kind of computer like a server or a personal computer, or the like, or any combination thereof. The device may also include means which could be e.g. hardware means like e.g. an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA), or a combination of hardware and software means, e.g. an ASIC and an FPGA, or at least one microprocessor and at least one memory with software modules located therein. Thus, the means can include both hardware means and software means. The method embodiments described herein could be implemented in hardware and software. The device may also include software means. Alternatively, the embodiments may be implemented on different hardware devices, e.g. using a plurality of CPUs.

[0044] The embodiments herein can comprise hardware and software elements. The embodiments that are implemented in software include but are not limited to, firmware, resident software, microcode, etc. The functions performed by various modules described herein may be implemented in other modules or combinations of other modules. For the purposes of this description, a computer-usable or computer readable medium can be any apparatus that can comprise, store, communicate, propagate, or transport the program for use by or in connection with the instruction execution system, apparatus, or device.

[0045] The illustrated steps are set out to explain the embodiments shown. These examples are presented herein for purposes of illustration, and not limitation. Further, the boundaries of the functional building blocks have been arbitrarily defined herein for the convenience of the description. Alternative boundaries can be defined so long as the specified functions and relationships thereof are appropriately performed. Alternatives (including extensions, variations, deviations, etc., of those described herein) will be apparent to persons skilled in the relevant arts based on the teachings contained herein. Such alternatives fall within the scope of the disclosed embodiments. Also, the words "comprising," "having," "containing," and "including," and other similar forms are intended to be equivalent in meaning and be open ended in that an item or items following any one of these words is not meant to be an exhaustive listing of such item or items, or meant to be limited to only the listed item or items.

[0046] Furthermore, one or more computer-readable storage media may be utilized in implementing embodiments consistent with the present disclosure. A computer-readable storage medium refers to any type of physical memory on which information or data readable by a processor may be stored. Thus, a computer-readable storage medium may store instructions for execution by one or more processors, including instructions for causing the processor(s) to perform steps or stages consistent with the embodiments described herein. The term "computer-readable medium" should be understood to include tangible items and exclude carrier waves and transient signals, i.e., be non-transitory. Examples include random access memory (RAM), read-only memory (ROM), volatile memory, nonvolatile memory, hard drives, CD ROMs, DVDs, flash drives, disks, and any other known physical storage media.

[0047] It is intended that the disclosure and examples be considered as exemplary only, with a true scope of disclosed embodiments being indicated by the following claims.

REFERENCES CITED IN THE DESCRIPTION

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Patentkrav

1. Fremgangsmåde (500) til ansigtspositionssporing og alarmering af en fører, hvilken fremgangsmåde omfatter:

registrering af et eller flere billeder gennem et monokulært kamera, hvor det monokulære kamera er positioneret i en sidevinkel fra førerens ansigt;

identificering af førerens ansigt fra et eller flere ansigter baseret på pladsen optaget i det ene eller flere billeder for at lagre førerens ansigt som et referenceansigt;

opdeling af førerens ansigt i et første område og et andet område og identificering af et eller flere hjørnepunkter fra det første område og det andet område af førerens ansigt;

frembringelse af et geometrisk tyngdepunkt i hvert af det første område og det andet område og forbindelse af det eller flere hjørnepunkter i det geometriske tyngdepunkt frembragt i hvert af det første område og det andet område under anvendelse af en flerhed af virtuelle linjer;

frembringelse af en flerhed af tætte virtuelle linjer baseret på bevægelse af førerens ansigt i en forudbestemt tidsperiode, hvor frembringelse af flerheden af tætte virtuelle linjer inkluderer udligning af ansigtsområder og anvendelse af et Laplace-filter for at fremhæve kanter af førerens ansigt;

sporing af variationer som skyldes bevægelsen af førerens ansigt ved beregning af en eller flere flowvektorer baseret på størrelsesværdi og en faseværdi af det ene eller flere hjørnepunkter;

frembringelse af et eller flere nye hjørnepunkter og frembringelse af en eller flere flowvektorer ved at udsætte det ene eller flere nye hjørnepunkter for en optisk flowramme, hvor et eller flere nye hjørnepunkter frembringes baseret på en eller flere forudbestemte betingelser;

bestemmelse af en eller flere gyldige bevægelsesvektorer, en eller flere ugyldige bevægelsesvektorer og en eller flere statiske bevægelsesvektorer baseret på vinkel og størrelsesværdi af det ene eller flere nye hjørnepunkter; og

alarmering af føreren hvis vinklen og størrelsesværdien af den ene eller flere gyldige bevægelsesvektorer er større end en tærskelværdi.

2. Fremgangsmåden ifølge krav 1, hvor, hvis førerens ansigt er opmærksomt i den forudbestemte tidsperiode, størrelsesværdien og faseværdien nulstilles.

3. Fremgangsmåden ifølge krav 1, hvor den ene eller flere gyldige bevægelses-vektorer er den ene eller flere flowvektorer, hvis:

størrelsesværdien af den ene eller flere flowvektorer er inden for en foruddefineret størrelsesværdi; eller

flerheden af virtuelle linjer bevæger sig i samme retning eller udviser homogen skalering, eller der er samtidig tilstedeværelse af vektorer.

4. Fremgangsmåden ifølge krav 1, hvor den ene eller flere ugyldige bevægelses-vektorer er den ene eller flere flowvektorer, hvis:

størrelsesværdien af den ene eller flere flowvektorer er større end den foruddefinerede størrelsesværdi; eller

flerheden af virtuelle linjer ikke bevæger sig i samme retning; eller

ikke udviser homogen skalering; eller

der ikke er samtidig tilstedeværelse af vektorer.

5. Fremgangsmåden ifølge krav 1, hvor den ene eller flere statiske bevægelses-vektorer er den ene eller flere flowvektorer, hvis størrelsesværdien af den ene eller flere flowvektorer er konstant.

6. Fremgangsmåden ifølge krav 1, hvor registrering af et eller flere ansigter og identificering af en førers ansigt baseret på rummet optaget i billedet udføres under anvendelse af en Haar-cascade-classifier-algoritme.

7. Fremgangsmåden ifølge krav 1, hvor de foruddefinerede betingelser er:

førerens ansigt er ikke synligt; eller

den ene eller flere virtuelle linjer registrerer ikke førerens ansigt grundet for hurtig bevægelse; eller

afvigelse af førerens ansigt er større end en tærskelværdi.

8. System (100) til ansigtspositionssporing og alarmering af en fører, hvilket system omfatter:

mindst en processor (202); og
en hukommelse (104) kommunikativt koblet til den mindst ene processor, hvor hukommelsen omfatter:
et ansigtssporingsmodul (106) til:
at registrere et eller flere billeder gennem et monokulært kamera, hvor det monokulære kamera er positioneret i en sidevinkel fra førerens ansigt;
at identificere førerens ansigt fra et eller flere ansigter baseret på pladsen optaget i det ene eller flere billeder for at lagre førerens ansigt som et referenceansigt;
at opdele det identificerede ansigt i et første område og et andet område og identificere et eller flere hjørnepunkter fra det første område og det andet område af førerens ansigt;
at frembringe et geometrisk tyngdepunkt i hvert det første område og det andet område og forbinde det ene eller flere hjørnepunkter i det geometriske tyngdepunkt frembragt i hvert af det første område og det andet område under anvendelse af en flerhed af virtuelle linjer;
at frembringe en flerhed af tætte virtuelle linjer, baseret på bevægelse af førerens ansigt i en foruddefineret tidsperiode, hvor frembringelse af flerheden af tætte virtuelle linjer inkluderer udligning af ansigtsområder og anvendelse af et Laplace-filter til at fremhæve kanter af førerens ansigt;
at spore variationer som skyldes bevægelsen af førerens ansigt ved beregning af en eller flere flowvektorer baseret på en størrelsesværdi og en faseværdi af det ene eller flere hjørnepunkter;
at frembringe et eller flere nye hjørnepunkter og at frembringe en eller flere flowvektorer ved at udsætte det ene eller flere nye hjørnepunkter for en optisk flowramme, hvor et eller flere nye hjørnepunkter frembringes baseret på en eller flere foruddefinerede betingelser;
at bestemme en eller flere gyldige bevægelsesvektorer, en eller flere ugyldige bevægelsesvektorer og en eller flere statiske bevægelsesvektorer baseret på en vinkel og størrelsesværdi af det ene eller flere nye hjørnepunkter; og
at alarmere føreren hvis vinklen og størrelsesværdien af den ene eller flere gyldige bevægelsesvektorer er større end en tærskelværdi.

9. Systemet ifølge krav 8, hvor, hvis førerens ansigt er opmærksomt i den foruddefinerede tidsperiode, størrelsesværdien og faseværdien nulstilles.

10. Systemet ifølge krav 8, hvor den ene eller flere gyldige bevægelsesvektorer er den ene eller flere flowvektorer, hvis størrelsesværdien af den ene eller flere flowvektorer er inden for en foruddefineret størrelsesværdi, eller flerheden af virtuelle linjer bevæger sig i samme retning eller udviser homogen skalering, eller der er samtidig tilstedeværelse af vektorer.

11. Systemet ifølge krav 8, hvor den ene eller flere ugyldige bevægelsesvektorer er den ene eller flere flowvektorer, hvis størrelsesværdien af den ene eller flere flowvektorer er større end den foruddefinerede størrelsesværdi, eller flerheden af virtuelle linjer ikke bevæger sig i samme retning eller ikke udviser homogen skalering, eller der ikke er samtidig tilstedeværelse af vektorer.

12. Systemet ifølge krav 8, hvor den ene eller flere statiske bevægelsesvektorer er den ene eller flere flowvektorer, hvis størrelsesværdien af den ene eller flere flowvektorer er konstant.

13. Systemet ifølge krav 8, hvor registrering af et eller flere ansigter og identificering af en førers ansigt baseret på rummet optaget i billedet udføres under anvendelse af Haar-cascade-classifier-algoritme.

14. Systemet ifølge krav 8, hvor de foruddefinerede betingelser er:

førerens ansigt er ikke synligt; eller

den ene eller flere virtuelle linjer registrerer ikke førerens ansigt grundet for hurtig bevægelse; eller

afvigelse af førerens ansigt er større end en tærskelværdi.

15. Ikke-transitorisk computerlæsbart medie som lagrer instruktioner, som, når de eksekveres af en hardwareprocessor, forårsager:

registrering af et eller flere billeder gennem et monokulært kamera, hvor det monokulære kamera er positioneret i en sidevinkel fra førerens ansigt;

identificering af førerens ansigt fra et eller flere ansigter baseret på pladsen optaget i det ene eller flere billeder for at lagre førerens ansigt som et referenceansigt;

opdeling af førerens ansigt i et første område og et andet område og identificering af et eller flere hjørnepunkter fra det første område og det andet område af førerens ansigt;

frembringelse af et geometrisk tyngdepunkt i hvert af det første område og det andet område og forbindelse af det ene eller flere hjørnepunkter i det geometriske tyngdepunkt i hvert af første område og det andet område under anvendelse af en flerhed af virtuelle linjer;

frembringelse af en flerhed af tætte virtuelle linjer, baseret på bevægelse af førerens ansigt i en foruddefineret tidsperiode, hvor frembringelse af flerheden af tætte virtuelle linjer inkluderer udligning af ansigtsområder og anvendelse af et Laplace-filter for at fremhæve kanter af førerens ansigt;

sporing af variationer som skyldes bevægelsen af førerens ansigt ved beregning af en eller flere flowvektorer baseret på en størrelsesværdi og en faseværdi af det ene eller flere hjørnepunkter;

frembringelse af et eller flere nye hjørnepunkter og frembringelse af en eller flere flowvektorer ved at udsætte det ene eller flere nye hjørnepunkter for en optisk flowramme, hvor et eller flere nye hjørnepunkter frembringes baseret på en eller flere foruddefinerede betingelser;

bestemmelse af en eller flere gyldige bevægelsesvektorer, en eller flere ugyldige bevægelsesvektorer og en eller flere statiske bevægelsesvektorer baseret på en vinkel og størrelsesværdi af det ene eller flere nye hjørnepunkter; og

alarmering af føreren hvis vinklen og størrelsesværdien af den ene eller flere gyldige bevægelsesvektorer er større end en tærskelværdi.

16. Det ikke-transitoriske computerlæsbare medie ifølge krav 15, hvor, hvis førerens ansigt er opmærksomt i den foruddefinerede tidsperiode, størrelses-værdien og faseværdien nulstilles for at undgå en falsk alarm grundet akkumulering af støjende bevægelser.

17. Det ikke-transitoriske computerlæsbare medie ifølge krav 15, hvor den ene eller flere gyldige bevægelsesvektorer er den ene eller flere flowvektorer, hvis:

størrelsesværdien af den ene eller flere flowvektorer er inden for en foruddefineret størrelsesværdi; eller

flerheden af virtuelle linjer bevæger sig i samme retning eller udviser homogen skalering, eller der er samtidig tilstedeværelse af vektorer.

DRAWINGS

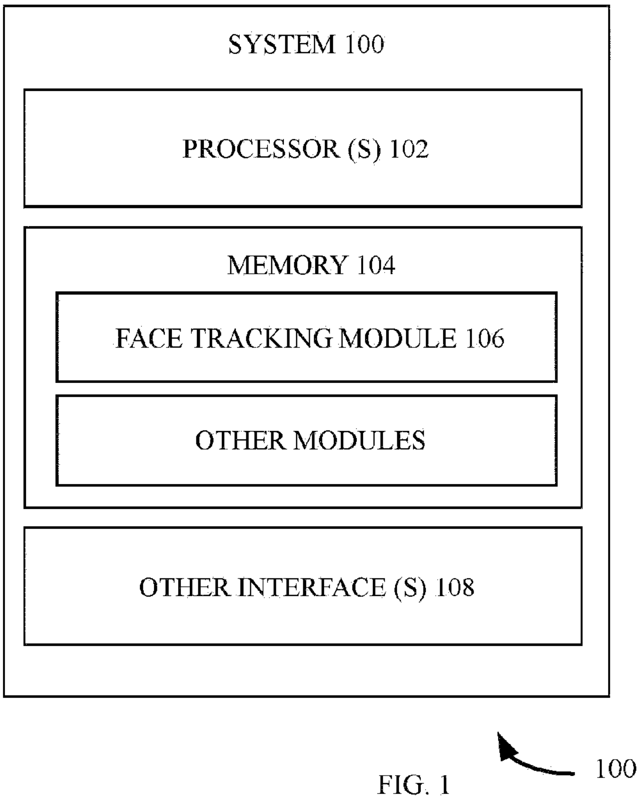

FIG. 1

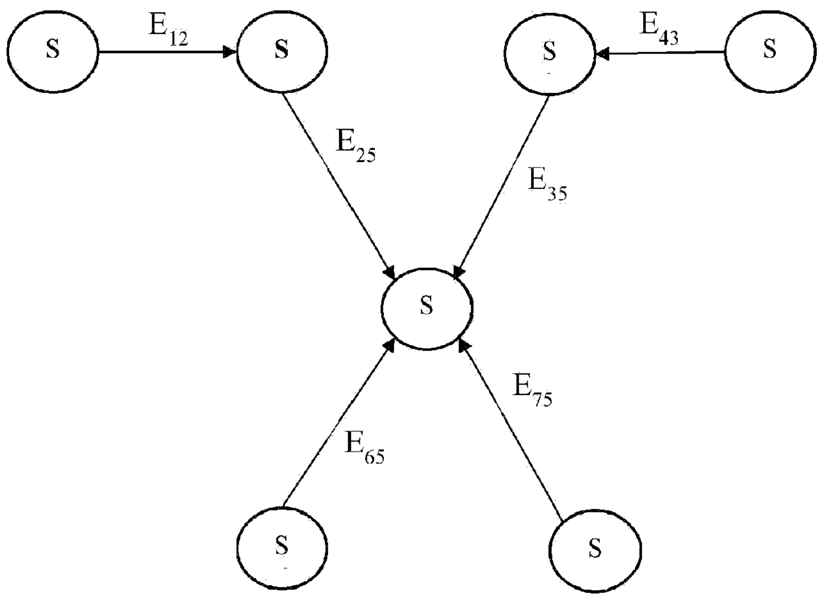

FIG. 2

FIG. 3(a) FIG. 3(b)

FIG. 3

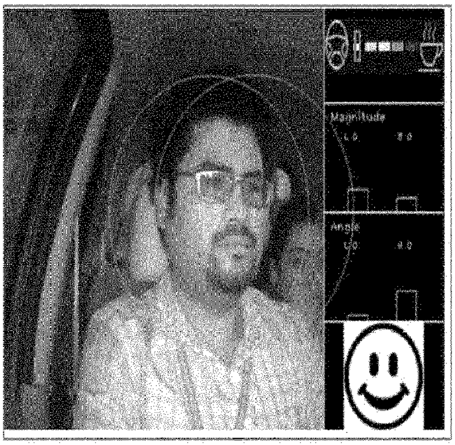

FIG. 4(a)

FIG. 4(b)

FIG. 4

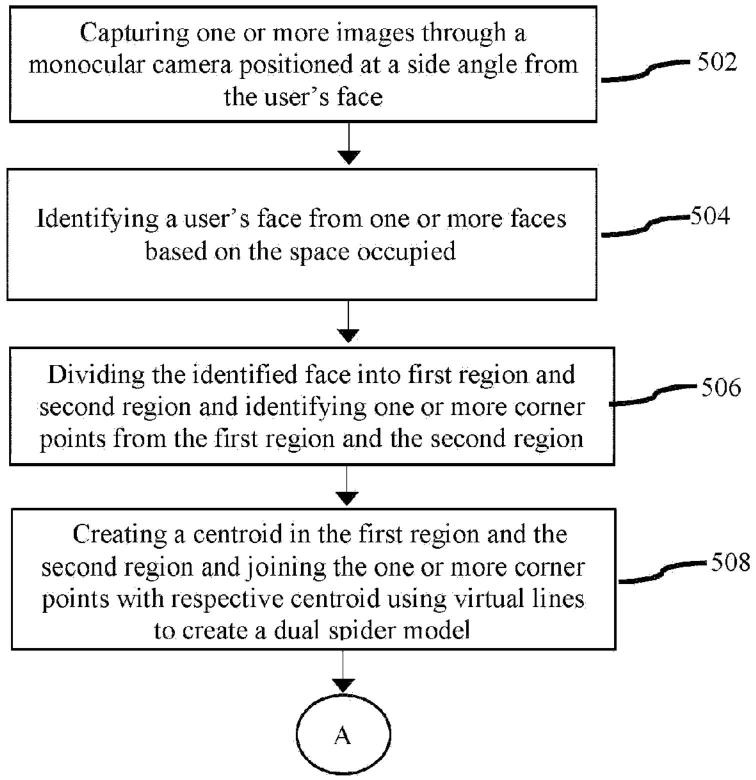
Capturing one or more images through a monocular camera positioned at a side angle from the user's face
502
Identifying a user's face from one or more faces based on the space occupied
504
Dividing the identified face into first region and second region and identifying one or more corner points from the first region and the second region
506
Creating a centroid in the first region and the second region and joining the one or more corner points with respective centroid using virtual lines to create a dual spider model
508
A

FIG. 5a

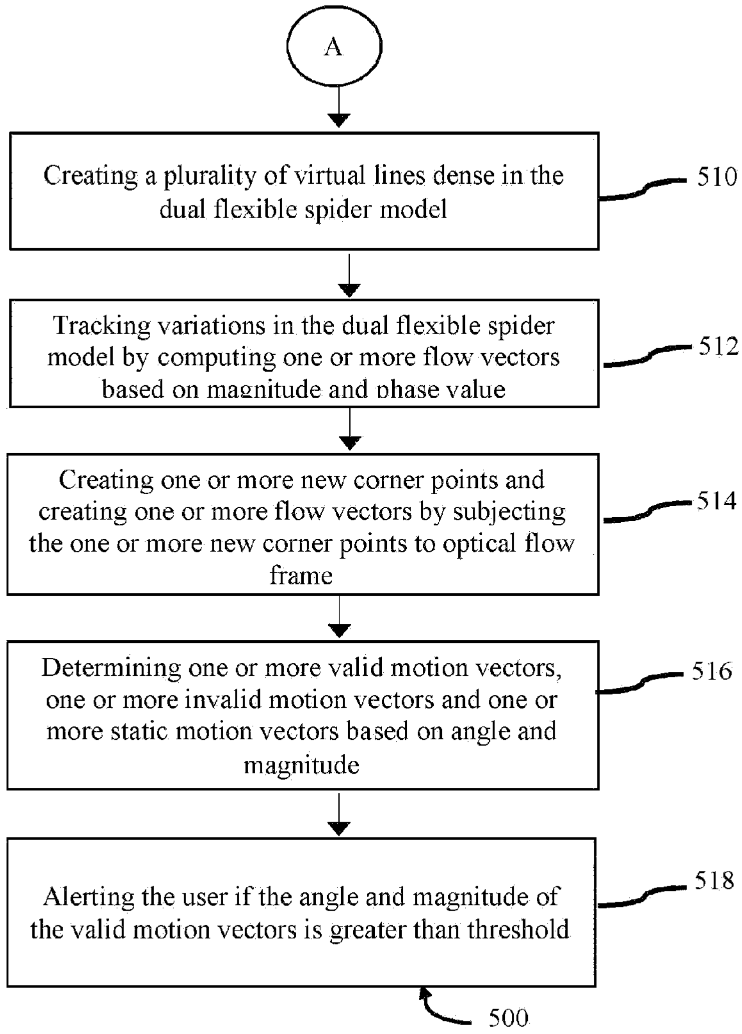
A
Creating a plurality of virtual lines dense in the dual flexible spider model
510
Tracking variations in the dual flexible spider model by computing one or more flow vectors based on magnitude and phase value
512
Creating one or more new corner points and creating one or more flow vectors by subjecting the one or more new corner points to optical flow frame
514
Determining one or more valid motion vectors, one or more invalid motion vectors and one or more static motion vectors based on angle and magnitude
516
Alerting the user if the angle and magnitude of the valid motion vectors is greater than threshold
518
500

FIG. 5b