United States Patent Application Publication	20250263013
Kind Code	A1
Publication Date	August 21, 2025
Inventor(s)	KIMANI; Everlyne N.

SYSTEM AND METHOD FOR PROVIDING HAPTIC FEEDBACK TO INFLUENCE AN AFFECTIVE STATE

Abstract

A method for regulating an affective state of a driver includes transmitting, to a remote monitoring system, vital sign data of the driver in accordance with monitoring one or more vital signs of the driver. The method also includes receiving, from the remote monitoring system, haptic feedback data in accordance with a vital sign, of the one or more vital signs, satisfying a stimulation condition, the haptic feedback data indicating a vital sign pattern of a remote instructor. The method additionally includes providing haptic feedback to the driver in accordance with receiving the haptic feedback data.

Inventors: **KIMANI; Everlyne N. (Mountain View, CA)**

Applicant: **TOYOTA RESEARCH INSTITUTE, INC.** (Los Altos, CA)

Family ID: **1000007708950**

Assignee: **TOYOTA RESEARCH INSTITUTE, INC. (Los Altos, CA); TOYOTA JIDOSHA KABUSHIKI KAISHA (Aichi-Ken, JP)**

Appl. No.: **18/582500**

Filed: **February 20, 2024**

Publication Classification

Int. Cl.: **B60Q9/00** (20060101); **A61B5/00** (20060101); **A61B5/08** (20060101); **G09B19/16** (20060101)

U.S. Cl.:

CPC **B60Q9/00** (20130101); **A61B5/0002** (20130101); **A61B5/0816** (20130101); **A61B5/6801** (20130101); **A61B5/6893** (20130101); **A61B5/7455** (20130101); **G09B19/167** (20130101); A61B2503/22 (20130101)

Background/Summary

BACKGROUND
Field
[0001] Certain aspects of the present disclosure generally relate to driver training and, more specifically, to systems and methods for providing haptic feedback to influence an affective state.
Background
[0002] Haptic feedback refers to the tactile or touch-based sensations and/or cues provided by one or more electronic devices to users. Haptic feedback involves the use of vibrations, forces, or motions to simulate the sense of touch, enhancing the user experience by creating physical interactions between the user and a digital interface. Devices such as smartphones, game controllers, and wearables use haptic feedback to convey information or responses, such as confirming a button press, simulating textures or surfaces, or providing alerts and notifications through subtle vibrations or motions. This sensory feedback creates a more immersive and intuitive interaction, allowing users to perceive and respond to digital stimuli through physical sensations.
[0003] Conventional systems use various ways to monitor physiological and psychological arousal states. For example, wearable devices equipped with heart rate monitors and accelerometers can track physiological indicators, providing real-time data on stress levels. Heart-rate monitors may analyze variations in an individual's heart rate to infer stress levels. By continuously tracking the heart's beats per minute (bpm) and assessing patterns, deviations, and/or irregularities from a baseline, specialized techniques can identify potential stress indicators. Other vital signs, such as breathing patterns, pupil dilation, blood pressure, muscle tension, skin conductance, and perspiration, may indicate stress levels. Smart wearables may monitor these vital signs to infer and assess user stress.
SUMMARY
[0004] In one aspect of the present disclosure, a method for regulating an affective state of a driver includes transmitting, to a remote monitoring system, vital sign data of the driver in accordance with monitoring one or more vital signs of the driver. The method also includes receiving, from the remote monitoring system, haptic feedback data in accordance with a vital sign, of the one or more vital signs, satisfying a stimulation condition, the haptic feedback data indicating a vital sign pattern of a remote instructor. The method additionally includes providing haptic feedback to the driver in accordance with receiving the haptic feedback data.
[0005] Another aspect of the present disclosure is directed to an apparatus for regulating an affective state of a driver, including means for transmitting, to a remote monitoring system, vital sign data of the driver in accordance with monitoring one or more vital signs of the driver. The apparatus also includes means for receiving, from the remote monitoring system, haptic feedback data in accordance with a vital sign, of the one or more vital signs, satisfying a stimulation condition, the haptic feedback data indicating a vital sign pattern of a remote instructor. The apparatus further includes means for providing haptic feedback to the driver in accordance with

receiving the haptic feedback data.
[0006] In another aspect of the present disclosure, a non-transitory computer-readable medium with non-transitory program code recorded thereon for regulating an affective state of a driver is disclosed. The program code is executed by a processor and includes program code to transmit, to a remote monitoring system, vital sign data of the driver in accordance with monitoring one or more vital signs of the driver. The program code further includes program code to receive, from the remote monitoring system, haptic feedback data in accordance with a vital sign, of the one or more vital signs, satisfying a stimulation condition, the haptic feedback data indicating a vital sign pattern of a remote instructor. The program code further includes program code to provide haptic feedback to the driver in accordance with receiving the haptic feedback data.
[0007] Another aspect of the present disclosure is directed to an apparatus for regulating an affective state of a driver. The apparatus includes one or more memories coupled with the one or more processors and storing instructions operable, when executed by the one or more processors, to cause the apparatus to transmit, to a remote monitoring system, vital sign data of the driver in accordance with monitoring one or more vital signs of the driver. Execution of the instructions also cause the apparatus to receive, from the remote monitoring system, haptic feedback data in accordance with a vital sign, of the one or more vital signs, satisfying a stimulation condition, the haptic feedback data indicating a vital sign pattern of a remote instructor. Execution of the instructions further cause the apparatus to provide haptic feedback to the driver in accordance with receiving the haptic feedback data.
[0008] Aspects generally include a method, apparatus, system, computer program product, non-transitory computer-readable medium, user equipment, base station, wireless communication device, and processing system as substantially described with reference to and as illustrated by the accompanying drawings and specification.
[0009] The foregoing has outlined rather broadly the features and technical advantages of examples according to the disclosure in order that the detailed description that follows may be better understood. Additional features and advantages will be described. The conception and specific examples disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present disclosure. Such equivalent constructions do not depart from the scope of the appended claims. Characteristics of the concepts disclosed, both their organization and method of operation, together with associated advantages will be better understood from the following description when considered in connection with the accompanying figures. Each of the figures is provided for the purposes of illustration and description, and not as a definition of the limits of the claims.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0010] The features, nature, and advantages of the present disclosure will become more apparent from the detailed description set forth below when taken in conjunction with the drawings in which like reference characters identify correspondingly throughout.
[0011] FIG. **1**A is a diagram illustrating an example of a vehicle in an environment, in accordance with various aspects of the present disclosure.
[0012] FIG. **1**B is a diagram illustrating an example of a vehicle, in accordance with various aspects of the present disclosure.
[0013] FIG. **2** is a block diagram illustrating a software architecture that may modularize artificial intelligence (AI) functions for planning and control of an autonomous agent, in accordance with various aspects of the present disclosure.
[0014] FIG. **3** is a diagram illustrating an example of a hardware implementation for a vehicle

control system, in accordance with various aspects of the present disclosure.

[0015] FIG. **4** is a timing diagram illustrating an example of providing haptic feedback to a driver via a haptic feedback system, in accordance with aspects of the present disclosure.

[0016] FIG. **5** illustrates an example of a driver wearing a vital monitoring device, in accordance with aspects of the present disclosure.

[0017] FIG. **6** is a flow diagram illustrating an example process for regulating an affective state of a driver, in accordance with aspects of the present disclosure.

DETAILED DESCRIPTION

[0018] Various aspects of the disclosure are described more fully below with reference to the accompanying drawings. This disclosure may, however, be embodied in many different forms and should not be construed as limited to any specific structure or function presented throughout this disclosure. Rather, these aspects are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the disclosure to those skilled in the art. Based on the teachings, one skilled in the art should appreciate that the scope of the disclosure is intended to cover any aspect of the disclosure, whether implemented independently of or combined with any other aspect of the disclosure. For example, an apparatus may be implemented or a method may be practiced using any number of the aspects set forth. In addition, the scope of the disclosure is intended to cover such an apparatus or method, which is practiced using other structure, functionality, or structure and functionality in addition to or other than the various aspects of the disclosure set forth. It should be understood that any aspect of the disclosure disclosed may be embodied by one or more elements of a claim.

[0019] Several aspects of haptic feedback systems will now be presented with reference to various apparatuses and techniques. These apparatuses and techniques will be described in the following detailed description and illustrated in the accompanying drawings by various blocks, modules, components, circuits, steps, processes, algorithms, and/or the like (collectively referred to as “elements”). These elements may be implemented using hardware, software, or combinations thereof. Whether such elements are implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system.

[0020] Conventional driver training systems rely on a human instructor to provide guidance during driver training sessions. In these systems, a driving instructor sits in the passenger seat of a training vehicle and verbally provides feedback to a student in the driver seat. One aspect of this feedback involves addressing the driver's affective state. For instance, if the driver becomes anxious or excited, the instructor may instruct the driver to calm down and regain control.

[0021] However, verbal feedback directly addressing emotions often yields limited results, as people typically do not respond well to such verbal instructions. For example, when told to “calm down,” individuals may instead experience heightened anxiety. The instructor's physical presence next to the driver may also increase a driver's anxiety, as some drivers might become distracted, more self-aware, or intimidated by the teacher.

[0022] Various aspects of the present disclosure are directed to a method for regulating a driver's emotional state during training via a remote instructor. In some examples, a local monitoring system tracks a student driver's vital sign data. For example, the local monitoring system may track one or more vital signs of a driver, such as heart rate, pupil dilation, breathing patterns, blood pressure, muscle tension, skin conductance, or perspiration levels. If any of these vital signs satisfy a stimulation condition, the local monitoring system may then transmit an indication to a remote monitoring system associated with a driving instructor. The stimulation condition may be satisfied based on one or more vitals signs being above or below a respective baseline and/or determining an abnormal condition. Of course, other criteria are contemplated for satisfying the stimulation condition. In one example, the stimulation condition is satisfied if the driver's heart rate exceeds a beat per minute (BPM) threshold. Additionally, or alternatively, the stimulation condition may be satisfied if the driver's breathing pattern becomes irregular.

[0023] Once the remote monitoring system receives the indication, the driving instructor can respond by initiating haptic feedback. The haptic feedback may mimic one or more vital signs of the instructor. For example, the driving instructor may demonstrate a controlled breathing technique. The system translates the instructor's vital signs, such as breathing patterns, into the haptic feedback pattern (e.g., vibration pattern). The haptic feedback pattern may then be imparted on the driver via a haptic feedback device in the driver's chair, headrest, or attire (e.g., a haptic feedback vest). As the driver receives the haptic feedback provided by the instructor, the driver may naturally synchronize one or more physical conditions, such as their breathing pattern, with the haptic feedback pattern received from the remote instructor. As such, the driver may effectively mirror the instructor's vital sign pattern, such as the instructor's breathing pattern. This process facilitates a calming effect and helps the driver regulate their affective state, promoting a sense of focus and composure behind the wheel. Various aspects of the present disclosure are not limited to regulating the affective state of the driver of a car. Such aspects are also contemplated for remotely regulating the affective state of other people. Such people include, but are not limited to, pilots, astronauts, boat captains, or other people in stress inducing situations.
[0024] Particular aspects of the subject matter described in this disclosure can be implemented to realize one or more of the following potential advantages. In some examples, the described techniques, such as providing haptic feedback to an anxious driver, enables an instructor to deliver interventions for emotional regulation during training sessions. Other advantages include techniques for enabling an instructor to communicate with a driver from a remote location, as well as techniques for enhancing safety and performance during the training process.
[0025] FIG. **1**A is a diagram illustrating an example of a vehicle **100** in an environment **150**, in accordance with various aspects of the present disclosure. In the example of FIG. **1**A, the vehicle **100** may be an autonomous vehicle, a semi-autonomous vehicle, or a non-autonomous vehicle. As shown in FIG. **1**A, the vehicle **100** may be traveling on a road **110**. A first vehicle **104** may be ahead of the vehicle **100** and a second vehicle **116** may be adjacent to the vehicle **100**. In this example, the vehicle **100** may include a 2D camera **108**, such as a 2D red-green-blue (RGB) camera, and a LIDAR sensor **106**. Other sensors, such as RADAR and/or ultrasound, are also contemplated. Additionally, or alternatively, although not shown in FIG. **1**A, the vehicle **100** may include one or more additional sensors, such as a camera, a RADAR sensor, and/or a LIDAR sensor, integrated with the vehicle in one or more locations, such as within one or more storage locations (e.g., a trunk). Additionally, or alternatively, although not shown in FIG. **1**A, the vehicle **100** may include one or more force measuring sensors.
[0026] In one configuration, the 2D camera **108** captures a 2D image that includes objects in the 2D camera's **108** field of view **114**. The LIDAR sensor **106** may generate one or more output streams. The first output stream may include a 3D cloud point of objects in a first field of view, such as a 360° field of view **112** (e.g., bird's eye view). The second output stream **124** may include a 3D cloud point of objects in a second field of view, such as a forward-facing field of view **126**.
[0027] The 2D image captured by the 2D camera includes a 2D image of the first vehicle **104**, as the first vehicle **104** is in the 2D camera's **108** field of view **114**. As is known to those of skill in the art, a LIDAR sensor **106** uses laser light to sense the shape, size, and position of objects in the environment **150**. The LIDAR sensor **106** may vertically and horizontally scan the environment **150**. In the current example, the artificial neural network (e.g., autonomous driving system) of the vehicle **100** may extract height and/or depth features from the first output stream. In some examples, an autonomous driving system of the vehicle **100** may also extract height and/or depth features from the second output stream.
[0028] The information obtained from the sensors **106**, **108** may be used to evaluate a driving environment. Additionally, or alternatively, information obtained from one or more sensors that monitor objects within the vehicle **100** and/or forces generated by the vehicle **100** may be used to generate notifications when an object may be damaged based on actual, or potential, movement.

[0029] FIG. **1**B is a diagram illustrating an example the vehicle **100**, in accordance with various aspects of the present disclosure. It should be understood that various aspects of the present disclosure may be applicable to/used in various vehicles (internal combustion engine (ICE) vehicles, fully electric vehicles (EVs), etc.) that are fully or partially autonomously controlled/operated, and as noted above, even in non-vehicular contexts, such as, e.g., shipping container packing.

[0030] The vehicle **100** may include drive force unit **165** and wheels **170**. The drive force unit **165** may include an engine **180**, motor generators (MGs) **182** and **184**, a battery **195**, an inverter **197**, a brake pedal **186**, a brake pedal sensor **188**, a transmission **152**, a memory **154**, an electronic control unit (ECU) **156**, a shifter **158**, a speed sensor **160**, and an accelerometer **162**.

[0031] The engine **180** primarily drives the wheels **170**. The engine **180** can be an ICE that combusts fuel, such as gasoline, ethanol, diesel, biofuel, or other types of fuels which are suitable for combustion. The torque output by the engine **180** is received by the transmission **152**. MGs **182** and **184** can also output torque to the transmission **152**. The engine **180** and MGs **182** and **184** may be coupled through a planetary gear (not shown in FIG. **1**B). The transmission **152** delivers an applied torque to one or more of the wheels **170**. The torque output by engine **180** does not directly translate into the applied torque to the one or more wheels **170**.

[0032] MGs **182** and **184** can serve as motors which output torque in a drive mode, and can serve as generators to recharge the battery **195** in a regeneration mode. The electric power delivered from or to MGs **182** and **184** passes through the inverter **197** to the battery **195**. The brake pedal sensor **188** can detect pressure applied to brake pedal **186**, which may further affect the applied torque to wheels **170**. The speed sensor **160** is connected to an output shaft of transmission **152** to detect a speed input which is converted into a vehicle speed by ECU **156**. The accelerometer **162** is connected to the body of vehicle **100** to detect the actual deceleration of vehicle **100**, which corresponds to a deceleration torque.

[0033] The transmission **152** may be a transmission suitable for any vehicle. For example, transmission **152** can be an electronically controlled continuously variable transmission (ECVT), which is coupled to engine **180** as well as to MGs **91** and **92**. Transmission **20** can deliver torque output from a combination of engine **180** and MGs **91** and **92**. The ECU **156** controls the transmission **152**, utilizing data stored in memory **154** to determine the applied torque delivered to the wheels **170**. For example, ECU **156** may determine that at a certain vehicle speed, engine **180** should provide a fraction of the applied torque to the wheels **170** while one or both of the MGs **182** and **184** provide most of the applied torque. The ECU **156** and transmission **152** can control an engine speed (NE) of engine **180** independently of the vehicle speed (V).

[0034] The ECU **156** may include circuitry to control the above aspects of vehicle operation. Additionally, the ECU **156** may include, for example, a microcomputer that includes a one or more processing units (e.g., microprocessors), memory storage (e.g., RAM, ROM, etc.), and I/O devices. The ECU **156** may execute instructions stored in memory to control one or more electrical systems or subsystems in the vehicle. Furthermore, the ECU **156** can include one or more electronic control units such as, for example, an electronic engine control module, a powertrain control module, a transmission control module, a suspension control module, a body control module, and so on. As a further example, electronic control units can be included to control systems and functions such as doors and door locking, lighting, human-machine interfaces, cruise control, telematics, braking systems (e.g., anti-lock braking system (ABS) or electronic stability control (ESC)), battery management systems, and so on. These various control units can be implemented using two or more separate electronic control units or using a single electronic control unit.

[0035] The MGs **182** and **184** each may be a permanent magnet type synchronous motor including, for example, a rotor with a permanent magnet embedded therein. The MGs **182** and **184** may each be driven by an inverter controlled by a control signal from ECU **156** so as to convert direct current (DC) power from the battery **195** to alternating current (AC) power, and supply the AC power to the MGs **182** and **184**. In some examples, a first MG **182** may be driven by electric power generated by a second MG **184**. It should be understood that in embodiments where MGs **182** and **184** are DC motors, no inverter is required. The inverter, in conjunction with a converter assembly may also accept power from one or more of the MGs **182** and **184** (e.g., during engine charging), convert this power from AC back to DC, and use this power to charge battery **195** (hence the name, motor generator). The ECU **156** may control the inverter, adjust driving current supplied to the first MG **182**, and adjust the current received from the second MG **184** during regenerative coasting and braking.

[0036] The battery **195** may be implemented as one or more batteries or other power storage devices including, for example, lead-acid batteries, lithium ion, and nickel batteries, capacitive storage devices, and so on. The battery **195** may also be charged by one or more of the MGs **182** and **184**, such as, for example, by regenerative braking or by coasting during which one or more of the MGs **182** and **184** operates as generator. Alternatively or additionally, the battery **195** can be charged by the first MG **182**, for example, when vehicle **100** is in idle (not moving/not in drive). Further still, the battery **195** may be charged by a battery charger (not shown) that receives energy from engine **180**. The battery charger may be switched or otherwise controlled to engage/disengage it with battery **195**. For example, an alternator or generator may be coupled directly or indirectly to a drive shaft of engine **180** to generate an electrical current as a result of the operation of engine **180**. Still other embodiments contemplate the use of one or more additional motor generators to power the rear wheels of the vehicle **100** (e.g., in vehicles equipped with 4-Wheel Drive), or using two rear motor generators, each powering a rear wheel.

[0037] The battery **195** may also power other electrical or electronic systems in the vehicle **100**. In some examples, the battery **195** can include, for example, one or more batteries, capacitive storage units, or other storage reservoirs suitable for storing electrical energy that can be used to power one or both of the MGs **182** and **184**. When the battery **195** is implemented using one or more batteries, the batteries can include, for example, nickel metal hydride batteries, lithium ion batteries, lead acid batteries, nickel cadmium batteries, lithium ion polymer batteries, and other types of batteries.

[0038] FIG. **2** is a block diagram illustrating a software architecture **200** that may modularize artificial intelligence (AI) functions for planning and/or controlling one or more actions of the vehicle **100**, according to aspects of the present disclosure. Using the architecture, a controller application **202** may be designed such that it may cause various processing blocks of a system-on-chip (SOC) **220** (for example a central processing unit (CPU) **222**, a digital signal processor (DSP) **224**, a graphics processing unit (GPU) **226** and/or an network processing unit (NPU) **228**) to perform supporting computations during run-time operation of the controller application **202**.

[0039] The controller application **202** may be configured to call functions defined in a user space **204**. The controller application **202** may make a request to compile program code associated with a library defined in a taillight prediction application programming interface (API) **206** to perform taillight recognition of a vehicle. This request may ultimately rely on the output of a convolutional neural network configured to focus on portions of the sequence of images critical to vehicle taillight recognition.

[0040] A run-time engine **208**, which may be compiled code of a runtime framework, may be further accessible to the controller application **202**. The controller application **202** may cause the run-time engine **208**, for example, to take actions for controlling the autonomous agent. When a vehicle is detected within a predetermined distance of the autonomous agent, the run-time engine **208** may in turn send a signal to an operating system **210**, such as a Linux Kernel **212**, running on the SOC **220**. The operating system **210**, in turn, may cause a computation to be performed on the CPU **222**, the DSP **224**, the GPU **226**, the NPU **228**, or some combination thereof. The CPU **222** may be accessed directly by the operating system **210**, and other processing blocks may be accessed through a driver, such as drivers **214-218** for the DSP **224**, for the GPU **226**, or for the NPU **228**. In the illustrated example, the deep neural network may be configured to run on a combination of processing blocks, such as the CPU **222** and the GPU **226**, or may be run on the NPU **228**, if present.

[0041] FIG. **3** is a diagram illustrating an example of a hardware implementation for a vehicle control system **300**, according to aspects of the present disclosure. The vehicle control system **300** may be a component of a vehicle, a robotic device, or other device. For example, as shown in FIG. **3**, the vehicle control system **300** is a component of a vehicle **100**. Aspects of the present disclosure are not limited to the vehicle control system **300** being a component of the vehicle **100**, as other devices, such as a bus, boat, drone, or robot, are also contemplated for using the vehicle control system **300**. In the example of FIG. **3**, the vehicle system may include a local monitoring system **390**. In some examples, the local monitoring system **390** is configured to perform operations, including operations of the process **600** described with reference to FIG. **6**.

[0042] The vehicle control system **300** may be implemented with a bus architecture, represented generally by a bus **330**. The bus **330** may include any number of interconnecting buses and bridges depending on the specific application of the vehicle control system **300** and the overall design constraints. The bus **330** links together various circuits including one or more processors and/or hardware modules, represented by a processor **320**, a communication module **322**, a location module **318**, a sensor module **302**, a locomotion module **323**, a planning module **324**, and a computer-readable medium **313**. The bus **330** may also link various other circuits such as timing sources, peripherals, voltage regulators, and power management circuits, which are well known in the art, and therefore, will not be described any further.

[0043] The vehicle control system **300** includes a transceiver **314** coupled to the processor **320**, the sensor module **302**, a comfort module **308**, the communication module **322**, the location module **318**, the locomotion module **323**, the planning module **324**, and the computer-readable medium **313**. The transceiver **314** is coupled to an antenna **333**. The transceiver **314** communicates with various other devices over a transmission medium. For example, the transceiver **314** may receive commands via transmissions from a user or a remote device. As another example, the transceiver **314** may transmit driving statistics and information from the comfort module **308** to a server (not shown).

[0044] In one or more arrangements, one or more of the modules **302**, **313**, **314**, **318**, **320**, **322**, **323**, **324**, **390**, can include artificial or computational intelligence elements, such as, neural network, fuzzy logic or other machine learning algorithms. Further, in one or more arrangements, one or more of the modules **302**, **313**, **314**, **318**, **320**, **322**, **323**, **324**, **390** can be distributed among multiple modules **302**, **313**, **314**, **318**, **320**, **322**, **323**, **324**, **390** described herein. In one or more arrangements, two or more of the modules **302**, **313**, **314**, **318**, **320**, **322**, **323**, **324**, **390** of the vehicle control system **300** can be combined into a single module.

[0045] The vehicle control system **300** includes the processor **320** coupled to the computer-readable medium **313**. The processor **320** performs processing, including the execution of software stored on the computer-readable medium **313** providing functionality according to the disclosure. The software, when executed by the processor **320**, causes the vehicle control system **300** to perform the various functions described for a particular device, such as the vehicle **328**, or any of the modules **302**, **313**, **314**, **318**, **320**, **322**, **323**, **324**, **390**. The computer-readable medium **313** may also be used for storing data that is manipulated by the processor **320** when executing the software.

[0046] The sensor module **302** may be used to obtain measurements via different sensors, such as a first sensor **303**A and a second sensor **303**B. The first sensor **303**A and/or the second sensor **303**B may be a vision sensor, such as a stereoscopic camera or a red-green-blue (RGB) camera, for capturing 2D images. In some examples, one or both of the first sensor **303**A or the second sensor **303**B may be used to identify an intersection, a crosswalk, or another stopping location. Additionally, or alternatively, one or both of the first sensor **303**A or the second sensor **303**B may identify objects within a range of the vehicle **100**. In some examples, one or both of the first sensor **303**A or the second sensor **303**B may identify a pedestrian or another object in a crosswalk. The first sensor **303**A and the second sensor **303**B are not limited to vision sensors as other types of sensors, such as, for example, light detection and ranging (LiDAR), a radio detection and ranging (radar), sonar, and/or lasers are also contemplated for either of the sensors **303**A, **303**B. In some examples, the first sensor **303**A and/or the second sensor **303**B may include an internal sensor (e.g., within a cabin of the vehicle **100**) to monitor the driver.

[0047] The measurements of the first sensor **303**A and the second sensor **303**B may be processed by one or more of the processor **320**, the sensor module **302**, the comfort module **308**, the communication module **322**, the location module **318**, the locomotion module **323**, the planning module **324**, in conjunction with the computer-readable medium **313** to implement the functionality described herein. In one configuration, the data captured by the first sensor **303**A and the second sensor **303**B may be transmitted to an external device via the transceiver **314**. The first sensor **303**A and the second sensor **303**B may be coupled to the vehicle **328** or may be in communication with the vehicle **328**.

[0048] Additionally, the sensor module **302** may configure the processor **320** to obtain or receive information from the one or more sensors **303**A and **303**B. The information may be in the form of one or more two-dimensional (2D) image(s) and may be stored in the computer-readable medium **313** as sensor data. In the case of 2D, the 2D image is, for example, an image from the one or more sensors **303**A and **303**B that encompasses a field-of-view about the vehicle **100** of at least a portion of the surrounding environment, sometimes referred to as a scene. That is, the image is, in one approach, generally limited to a subregion of the surrounding environment. As such, the image may be of a forward-facing (e.g., the direction of travel) 30, 90, 120-degree field-of-view (FOV), a rear/side facing FOV, or some other subregion as defined by the characteristics of the one or more sensors **303**A and **303**B. In further aspects, the one or more sensors **303**A and **303**B may be an array of two or more cameras that capture multiple images of the surrounding environment and stitch the images together to form a comprehensive 330-degree view of the surrounding environment. In other examples, the one or more images may be paired stereoscopic images captured from the one or more sensors **303**A and **303**B having stereoscopic capabilities.

[0049] The location module **318** may be used to determine a location of the vehicle **328**. For example, the location module **318** may use a global positioning system (GPS) to determine the location of the vehicle **328**. The communication module **322** may be used to facilitate communications via the transceiver **314**. For example, the communication module **322** may be configured to provide communication capabilities via different wireless protocols, such as Wi-Fi, long term evolution (LTE), 3G, etc. The communication module **322** may also be used to communicate with other components of the vehicle **328** that are not modules of the vehicle control system **300**. Additionally, or alternatively, the communication module **322** may be used to communicate with an occupant of the vehicle **100**. Such communications may be facilitated via audio feedback from an audio system of the vehicle **100**, visual feedback via a visual feedback system of the vehicle, and/or haptic feedback via a haptic feedback device of the vehicle.

[0050] The locomotion module **323** may be used to facilitate locomotion of the vehicle **328**. As an example, the locomotion module **323** may control movement of the wheels. As another example, the locomotion module **323** may be in communication with a power source of the vehicle **328**, such as an engine or batteries. Of course, aspects of the present disclosure are not limited to providing locomotion via wheels and are contemplated for other types of components for providing locomotion, such as propellers, treads, fins, and/or jet engines.

[0051] The vehicle control system **300** also includes the planning module **324** for planning a route or controlling the locomotion of the vehicle **328**, via the locomotion module **323**. A route may be planned to a passenger based on compartment data provided via the comfort module **308**. In one configuration, the planning module **324** overrides the user input when the user input is expected (e.g., predicted) to cause a collision. The modules may be software modules running in the processor **320**, resident/stored in the computer-readable medium **313**, one or more hardware modules coupled to the processor **320**, or some combination thereof.

[0052] As shown in the example of FIG. **3**, the vehicle **100** may include a haptic feedback device **350**. The haptic feedback device **350** may be embedded in, or affixed to, a wearable device, such as a driver's vest or wristwatch. In some examples, the haptic feedback device **350** may be coupled to a structure in a vehicle. For example, the haptic feedback device **350** may be affixed to a portion of a seatbelt or embedded in a seat. The haptic feedback device **350** may provide tactile or touch sensation generated by electronic devices, providing physical feedback to a user through vibrations or other sensations. It is also contemplated that the haptic feedback device **350** may implement additional components suitable for conveying media. For example, the haptic feedback device **350** may include a speaker to create sound or a screen for displaying images.

[0053] The local monitoring system **390** may include or be in communication with the sensor module **302**, the transceiver **314**, the processor **320**, the communication module **322**, the location module **318**, the locomotion module **323**, the planning module **324**, the computer-readable medium **313**, the haptic feedback device **350**, and a vital monitoring device (illustrated with respect to FIG. **5**). In some examples, the local monitoring system **390** may implement a machine learning model. Working in conjunction with one or more of the sensors **303**A, **303**B, the sensor module **302**, and/or one or more other modules **313**, **314**, **318**, **320**, **322**, **323**, **324**, and **350**, the local monitoring system **390** may perform one or more operations, such as one or more operations associated with the elements of a process **600** described with reference to FIG. **6**.

[0054] FIG. **4** is a timing diagram illustrating an example of providing haptic feedback to a driver via a haptic feedback system, in accordance with various aspects of the present disclosure. As shown in the example of FIG. **4**, the a haptic feedback system may include various devices, such as the haptic feedback device **350** and the local monitoring system **390** illustrated with respect to FIG. **3**. In some examples, the local monitoring system **390** and the haptic feedback device **350** may be components of the same device. In other examples, the local monitoring system **390** and the haptic feedback device **350** may be separate devices.

[0055] The haptic feedback device **350** may be an example of a wearable device that provides haptic feedback. The wearable device may be worn by the user. The wearable device may be any type of device the provides haptic feedback, such as a haptic feedback vest, a wrist watch, a waist band, or another type of device. In other examples, the local monitoring system **390** and the haptic feedback device **350** may be separate devices. The local monitoring system **390** and the haptic feedback device **350** may communicate with each other via a local bus, a wireless signal, a wired signal, or another type of communication system. The local monitoring system **390** and the remote monitoring system **402** may communicate via wireless communications, such as cellular communication, Wi-Fi communication, or another type of wireless communication protocol.

[0056] The remote monitoring system **402** may include one or more devices, such as a tablet, smartphone, personal computer, server, laptop computer, smartwatch, or any other device capable of sending and receiving signals. In some examples, the remote monitoring system **402** may be associated with an application stored on a driving instructor's device, such as a computing device (e.g., laptop computer). As discussed, the remote monitoring system **402** may be in communication with the local monitoring system **390**.

[0057] As shown in the example of FIG. **4**, at t**1**, the local monitoring system **390** monitors one or more vital signs of a driver, such as the driver's breathing patterns, heart rate, blood pressure, muscle tension, skin conductance, and/or perspiration levels. To monitor the driver's vital signs, the local monitoring system **390** may implement conventional devices and techniques, such as fitness trackers, smartwatches equipped with health sensors, pulse oximeters, blood pressure monitors, cameras, and electrocardiogram (ECG or EKG) devices. Additionally, or alternatively, the local monitoring system **390** may include other types of wearable sensors and/or remote sensors. For example, the local monitoring system **390** may use in-seat sensors, steering wheel sensors, and/or one or more cameras within the vehicle to monitor one or more vital signs. The local monitoring system **390** and/or the remote monitoring system **402** may then use the vital sign data as an indicator of the driver's affective state.

[0058] By tracking the driver's vital signs, the local monitoring system **390** and/or the remote monitoring system **402** may determine that one or more vital signs have satisfied a stimulation condition. As an example, the stimulation condition may be satisfied if a respective vital sign is beyond a corresponding threshold. For example, an elevated heart rate often correlates with heightened emotions such as anxiety or excitement. Therefore, the stimulation condition may be satisfied if the heart rate is greater than a BPM threshold. As another example, elevated breathing may also satisfy a stimulation condition. Therefore, the stimulation condition may be satisfied if a number of breathes per second, or other time period, is greater than a breathing pattern rate.

[0059] At t**2**, the local monitoring system **390** transmits the vital sign data to the remote monitoring system **402**. The vital sign data includes vital sign information of the one or more monitored vital signs. In some examples, the local monitoring system **390** may continuously transmit the vital sign data to the remote monitoring system **402**. In still some examples, the local monitoring system **390** may periodically transmit the vital sign data. For example, the local monitoring system **390** may transmit the vital sign data every five seconds or once the local monitoring system **390** detects that the vital sign data satisfies a transmission condition.

[0060] The transmission condition may be satisfied when a monitored vital sign is greater than or less than an associated threshold, wherein the threshold is specific to the vital sign. In some examples, the transmission condition may be satisfied if the driver's heart rate is greater than a first threshold or less than a second threshold. For example, the first threshold may be a first number of BPM and the second threshold may be a second number of BPM. In this example, the transmission condition is satisfied if the driver's heart rate exceeds the first number of BPM or is less than the second number of BPM.

[0061] As discussed, the local monitoring system **390** may implement any number of monitoring systems and/or devices to measure vital sign data. It is contemplated that, in addition to or instead of vital sign data, the local monitoring system **390** may transmit some other affective state data to the remote monitoring system **402**, where the affective state information may indicate that emotional intervention is needed.

[0062] At t**3**, the remote monitoring system **402** generates haptic feedback data. The haptic feedback data may indicate a rhythm or intensity of vibrations. For example, a remote instructor, equipped with the driver's vital sign data, may initiate strategies to help the driver regulate their emotions and attain a calmer state. One such strategy involves the instructor modifying their own breathing pattern and generating haptic data (e.g., haptic feedback data) associated their breathing pattern to the local monitoring system **390**. That is, the haptic data may mimic the instructor's breathing pattern. By adopting slow, controlled breathing techniques, the instructor can demonstrate a sense of relaxation and composure. At t**4**, the remote monitoring system **402** transmits the haptic data to the local monitoring system **390**. It is contemplated that, in addition to or instead of haptic data, the remote monitoring system **402** may transmit, at time t**4**, audio and/or visual data associated with audio and/or visual cues. The haptic data, audio data, and/or visual data be referred to as intervention data.

[0063] At t**5**, the local monitoring system **390** transmits the haptic data to the haptic feedback device **350**. At t**6**, the haptic feedback device **350** generates haptic feedback based on the haptic data. In some examples, the haptic feedback device **350** may generate subtle vibrations or rhythms based on the haptic data. For example, the haptic feedback device **350** may transmit vibrations that correspond to a driving instructor's breathing patterns. The haptic feedback device **350** may be embedded in a wearable device or integrated into a vehicle component, such as a driver seat, headrest, or seatbelt. Additionally, or alternatively, the haptic feedback device **350** may play soothing sounds, such as soothing music or natural audio, based on data received from the local monitoring system **390**. Additionally, or alternatively, the haptic feedback device **350** may also provide visual cues to the driver based on data received from the local monitoring system **390**, such as a video or image illustrating proper breathing techniques.

[0064] The haptic feedback device **350** may continue to generate haptic feedback until one or more stop conditions are satisfied. In some examples, the local monitoring system **390** may continue to monitor the driver's vital signs. In response to the local monitoring system **390** detecting that the driver's vital signs have returned to a baseline or within range of a baseline, the local monitoring system **390** may signal the haptic feedback device **350** to stop generating haptic feedback. For example, if the driver's heart rate (e.g., BPM) returns to within a specified range, the local monitoring system **390** may signal the haptic feedback device **350** to stop generating haptic feedback.

[0065] Similarly, the remote monitoring system **402** may signal the local monitoring system **390** and/or the haptic feedback device **350** to stop generating haptic feedback in response to vital sign data received from the local monitoring system **390** indicating that the driver's vitals have returned to within a baseline. Additionally, or alternatively, the stop condition may be based on one or more conditions other than the driver's vitals. For example, the haptic feedback device **350** may generate haptic feedback until a specified amount of time has passed or the driver requesting to stop the haptic feedback, for example, by providing an input to stop the haptic feedback. The input may be received at an input device (e.g., a button or switch) on the haptic feedback device **350**.

[0066] It is also contemplated that various aspects of the present disclosure may be implemented to regulate a driver in ways other than calming the driver. For example, the local monitoring system **390** may detect the driver falling asleep, and, in response, the remote monitoring system **402** may generate haptic data in order to rouse the driver. In this example, the driver may wake up in response to receiving haptic feedback from the haptic feedback device **350**. Additionally, the vibrations, sounds, and/or visual cues generated by the haptic feedback device **350** may be based on intervention data received from the remote monitoring system **402**, such as haptic data, or may be based on predefined data stored by the local monitoring system **390** or another device in communication with the with the local monitoring system **390**. For example, the haptic data may indicate the rhythm of a vibration pattern while the intensity of the vibration pattern is already specified in the haptic feedback device **350**. As discussed, data generated by the remote monitoring system **402** may additionally or alternatively be associated with different aspects of the vibrations, sounds, and/or visual cues themselves. For example, data transmitted by the remote monitoring system **402** may include both the intensity and rhythm of a vibration pattern, as well as sounds to be conveyed to the driver.

[0067] Furthermore, the haptic feedback device **350**, local monitoring system **390**, and remote monitoring system **402** may be personalized to cater to individual driver preferences. For example, the haptic feedback device **350** may offer adjustable intensity levels, allowing the driver or instructor to choose the degree of haptic feedback the driver or instructor finds most effective in achieving affect regulation. Additionally, the driver or instructor may choose sensory stimuli conveyed by haptic feedback device **350**, such as sounds or visual cues to complement the haptic feedback and create a more immersive and calming experience.

[0068] Although the example illustrated with respect to FIG. **4** is described with respect to a driver and a driving instructor, other users are contemplated. For example, the haptic feedback device **350** may be embedded in a passenger seat of a car. In this example, the haptic feedback device **350** may provide haptic feedback to soothe a passenger in a car. Similarly, the haptic feedback device **350** may play calming sounds or display instructional images to an excited passenger. Although the example illustrated with respect to FIG. **4** illustrates three components, the haptic feedback device **350**, local monitoring system **390**, and remote monitoring system **402**, these components serve as an example. For instance, it is contemplated that more than two monitoring systems may be implemented to perform aspects of the present disclosure. It is also contemplated that the haptic feedback device **350** and the local monitoring system **390** may be incorporated into a single device, e.g., the wristwatch illustrated with respect to FIG. **5**.

[0069] FIG. **5** illustrates an example of a driver **500** wearing a vital monitoring device, in accordance with aspects of the present disclosure. As illustrated in FIG. **5**, the vital monitoring device may be a wristwatch **502**. The vital monitoring device may include one or more components to measure vital signs, such as a heart rate monitor. In some examples, the vital monitoring device may be coupled to the haptic feedback device **350** (not shown in the example of FIG. **5**) and/or the local monitoring system **390** (not shown in the example of FIG. **5**) described with respect to FIG. **3**. For example, the wristwatch **502** may include the vital monitoring device, the local monitoring system **390**, and the haptic feedback device **350**.

[0070] Although the example illustrated with respect to FIG. **5** shows the vital monitoring device as a wristwatch **502**, other configurations are contemplated. The vital monitoring device, local monitoring system **390**, and haptic feedback device **350** may be coupled to or integrated with one or more components, such as a seat **504**, seatbelt (not shown in FIG. **5**), headrest **506**, steering wheel, floorboard, or user attire **510**. For example, the vital monitoring device may be a heart monitor attached to a seatbelt. In this example, the haptic feedback device **350** may be a driver's seat **504** configured to vibrate. The local monitoring system **390** in this example may include or be in communication with the heart monitor, driver's seat **504**, and one or more other components, such as the processor **320** described with reference to FIG. **3**.

[0071] FIG. **6** is a flow diagram illustrating an example process for regulating an affective state of a driver, in accordance with some aspects of the present disclosure. The example process **600** is performed by one or both of a local monitoring system **390** or a haptic feedback device **350** as described with respect to FIGS. **3** and **4**. As shown in FIG. **6**, the process **600** begins at block **602** transmitting, to a remote monitoring system, vital sign data of the driver in accordance with monitoring one or more vital signs of the driver. The one or more vital signs may include, for example, heart rate, breathing patterns, pupil dilation, blood pressure, muscle tension, skin conductance, or perspiration levels. At block **604**, the process **600** receives, from the remote monitoring system, haptic feedback data in accordance with a vital sign, of the one or more vital signs, satisfying a stimulation condition, the haptic feedback data indicating a vital sign pattern of a remote instructor. For example, the vital sign pattern may be a breathing pattern demonstrated by the remote instructor. At block **606**, the process **600** provides haptic feedback to the driver in accordance with receiving the haptic feedback data. As discussed, the haptic feedback may be provided by the haptic feedback device **350**.

[0072] Based on the teachings, one skilled in the art should appreciate that the scope of the present disclosure is intended to cover any aspect of the present disclosure, whether implemented independently of or combined with any other aspect of the present disclosure. For example, an apparatus may be implemented or a method may be practiced using any number of the aspects set forth. In addition, the scope of the present disclosure is intended to cover such an apparatus or method practiced using other structure, functionality, or structure and functionality in addition to, or other than the various aspects of the present disclosure set forth. It should be understood that any aspect of the present disclosure may be embodied by one or more elements of a claim.

[0073] The word “exemplary” is used herein to mean “serving as an example, instance, or illustration.” Any aspect described herein as “exemplary” is not necessarily to be construed as preferred or advantageous over other aspects.

[0074] Although particular aspects are described herein, many variations and permutations of these aspects fall within the scope of the present disclosure. Although some benefits and advantages of the preferred aspects are mentioned, the scope of the present disclosure is not intended to be limited to particular benefits, uses or objectives. Rather, aspects of the present disclosure are intended to be broadly applicable to different technologies, system configurations, networks and protocols, some of which are illustrated by way of example in the figures and in the detailed description. The detailed description and drawings are merely illustrative of the present disclosure rather than limiting, the scope of the present disclosure being defined by the appended claims and equivalents thereof.

[0075] As used herein, the term “determining” encompasses a wide variety of actions. For example, “determining” may include calculating, computing, processing, deriving, investigating, looking up (e.g., looking up in a table, a database or another data structure), ascertaining and the like. Additionally, “determining” may include receiving (e.g., receiving information), accessing (e.g., accessing data in a memory) and the like. Furthermore, “determining” may include resolving, selecting, choosing, establishing, and the like.

[0076] As used herein, a phrase referring to “at least one of” a list of items refers to any combination of those items, including single members. As an example, “at least one of: a, b, or c” is intended to cover: a, b, c, a-b, a-c, b-c, and a-b-c.

[0077] The various illustrative logical blocks, modules and circuits described in connection with the present disclosure may be implemented or performed with a processor specially configured to perform the functions discussed in the present disclosure. The processor may be a neural network processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array signal (FPGA) or other programmable logic device (PLD), discrete gate or transistor logic, discrete hardware components or any combination thereof designed to perform the functions described herein. Alternatively, the processing system may comprise one or more neuromorphic processors for implementing the neuron models and models of neural systems described herein. The processor may be a microprocessor, controller, microcontroller, or state machine specially configured as described herein. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or such other special configuration, as described herein.

[0078] The steps of a method or algorithm described in connection with the present disclosure may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module may reside in storage or machine readable medium, including random access memory (RAM), read only memory (ROM), flash memory, erasable programmable read-only memory (EPROM), electrically erasable programmable read-only memory (EEPROM), registers, a hard disk, a removable disk, a CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that can be used to carry or store desired program code in the form of instructions or data structures and that can be accessed by a computer. A software module may comprise a single instruction, or many instructions, and may be distributed over several different code segments, among different programs, and across multiple storage media. A storage medium may be coupled to a processor such that the processor can read information from, and write information to, the storage medium. In the alternative, the storage medium may be integral to the processor.

[0079] The methods disclosed herein comprise one or more steps or actions for achieving the described method. The method steps and/or actions may be interchanged with one another without departing from the scope of the claims. In other words, unless a specific order of steps or actions is specified, the order and/or use of specific steps and/or actions may be modified without departing from the scope of the claims.

[0080] The functions described may be implemented in hardware, software, firmware, or any combination thereof. If implemented in hardware, an example hardware configuration may comprise a processing system in a device. The processing system may be implemented with a bus architecture. The bus may include any number of interconnecting buses and bridges depending on the specific application of the processing system and the overall design constraints. The bus may link together various circuits including a processor, machine-readable media, and a bus interface. The bus interface may be used to connect a network adapter, among other things, to the processing system via the bus. The network adapter may be used to implement signal processing functions.

For certain aspects, a user interface (e.g., keypad, display, mouse, joystick, etc.) may also be connected to the bus. The bus may also link various other circuits such as timing sources, peripherals, voltage regulators, power management circuits, and the like, which are well known in the art, and therefore, will not be described any further.
[0081] The processor may be responsible for managing the bus and processing, including the execution of software stored on the machine-readable media. Software shall be construed to mean instructions, data, or any combination thereof, whether referred to as software, firmware, middleware, microcode, hardware description language, or otherwise.
[0082] In a hardware implementation, the machine-readable media may be part of the processing system separate from the processor. However, as those skilled in the art will readily appreciate, the machine-readable media, or any portion thereof, may be external to the processing system. By way of example, the machine-readable media may include a transmission line, a carrier wave modulated by data, and/or a computer product separate from the device, all which may be accessed by the processor through the bus interface. Alternatively, or in addition, the machine-readable media, or any portion thereof, may be integrated into the processor, such as the case may be with cache and/or specialized register files. Although the various components discussed may be described as having a specific location, such as a local component, they may also be configured in various ways, such as certain components being configured as part of a distributed computing system.
[0083] The machine-readable media may comprise a number of software modules. The software modules may include a transmission module and a receiving module. Each software module may reside in a single storage device or be distributed across multiple storage devices. By way of example, a software module may be loaded into RAM from a hard drive when a triggering event occurs. During execution of the software module, the processor may load some of the instructions into cache to increase access speed. One or more cache lines may then be loaded into a special purpose register file for execution by the processor. When referring to the functionality of a software module below, it will be understood that such functionality is implemented by the processor when executing instructions from that software module. Furthermore, it should be appreciated that aspects of the present disclosure result in improvements to the functioning of the processor, computer, machine, or other system implementing such aspects.
[0084] If implemented in software, the functions may be stored or transmitted over as one or more instructions or code on a computer-readable medium. Computer-readable media include both computer storage media and communication media including any storage medium that facilitates transfer of a computer program from one place to another.
[0085] Further, it should be appreciated that modules and/or other appropriate means for performing the methods and techniques described herein can be downloaded and/or otherwise obtained by a user terminal and/or base station as applicable. For example, such a device can be coupled to a server to facilitate the transfer of means for performing the methods described herein. Alternatively, various methods described herein can be provided via storage means, such that a user terminal and/or base station can obtain the various methods upon coupling or providing the storage means to the device. Moreover, any other suitable technique for providing the methods and techniques described herein to a device can be utilized.
[0086] It is to be understood that the claims are not limited to the precise configuration and components illustrated above. Various modifications, changes, and variations may be made in the arrangement, operation, and details of the methods and apparatus described above without departing from the scope of the claims.

Claims

1. A method for regulating an affective state of a driver, comprising: transmitting, to a remote monitoring system, vital sign data of the driver in accordance with monitoring one or more vital signs of the driver; receiving, from the remote monitoring system, haptic feedback data in accordance with a vital sign, of the one or more vital signs, satisfying a stimulation condition, the haptic feedback data indicating a vital sign pattern of a remote instructor; and providing haptic feedback to the driver in accordance with receiving the haptic feedback data.

2. The method of claim 1, wherein the one or more vital signs include a heart rate, a breathing pattern, a pupil dilation level, a blood pressure level, muscle tension, skin conductance, or a perspiration level.

3. The method of claim 1, wherein the vital sign pattern is a breathing pattern.

4. The method of claim 1, wherein the one or more vital signs are monitored via one or more sensors incorporated within a vehicle and/or one or more wearable devices.

5. The method of claim 1, wherein the haptic feedback is provided via a wearable device or by a vehicle component.

6. The method of claim 1, wherein the vital sign data is continuously or periodically transmitted.

7. The method of claim 1, wherein the vital sign data is transmitted based on at least one of the one or more vital signs satisfying a transmission condition.

8. An apparatus for regulating an affective state of a driver, comprising: one or more processors; and one or more memories coupled with the one or more processors and storing instructions operable, when executed by the one or more processors, to cause the apparatus to: transmit, to a remote monitoring system, vital sign data of the driver in accordance with monitoring one or more vital signs of the driver; receive, from the remote monitoring system, haptic feedback data in accordance with a vital sign, of the one or more vital signs, satisfying a stimulation condition, the haptic feedback data indicating a vital sign pattern of a remote instructor; and provide haptic feedback to the driver in accordance with receiving the haptic feedback data.

9. The apparatus of claim 8, wherein the one or more vital signs include a heart rate, a breathing pattern, a pupil dilation level, a blood pressure level, muscle tension, skin conductance, or a perspiration level.

10. The apparatus of claim 8, wherein the vital sign pattern is a breathing pattern.

11. The apparatus of claim 8, wherein the one or more vital signs are monitored via one or more sensors incorporated within a vehicle and/or one or more wearable devices.

12. The apparatus of claim 8, wherein the haptic feedback is provided via a wearable device or by a vehicle component.

13. The apparatus of claim 8, wherein the vital sign data is continuously or periodically transmitted.

14. The apparatus of claim 8, wherein the vital sign data is transmitted based on at least one of the one or more vital signs satisfying a transmission condition.

15. A non-transitory computer-readable medium having program code recorded thereon for regulating an affective state of a driver, the program code executed by at least one processor and comprising: program code to transmit, to a remote monitoring system, vital sign data of the driver in accordance with monitoring one or more vital signs of the driver; program code to receive, from the remote monitoring system, haptic feedback data in accordance with a vital sign, of the one or more vital signs, satisfying a stimulation condition, the haptic feedback data indicating a vital sign pattern of a remote instructor; and program code to provide haptic feedback to the driver in accordance with receiving the haptic feedback data.

16. The non-transitory computer-readable medium of claim 15, wherein the one or more vital signs include a heart rate, a breathing pattern, a pupil dilation level, a blood pressure level, muscle tension, skin conductance, or a perspiration level.

17. The non-transitory computer-readable medium of claim 15, wherein the vital sign pattern is a breathing pattern.

18. The non-transitory computer-readable medium of claim 15, wherein the one or more vital signs are monitored via one or more sensors incorporated within a vehicle and/or one or more wearable devices.

19. The non-transitory computer-readable medium of claim 15, wherein the haptic feedback is provided via a wearable device or by a vehicle component.
20. The non-transitory computer-readable medium of claim 15, wherein: the vital sign data is continuously or periodically transmitted; and the vital sign data is transmitted based on at least one of the one or more vital signs satisfying a transmission condition.