

## SYSTEMS AND METHODS FOR GENERATING A DRIVER SCORE

### Field of the Disclosure

**[0001]** The present invention generally relates to data analytics and more specifically relates to systems and methods for generating a driver score.

---

### Background

**[0002]** The approaches described in this section could be pursued, but are not necessarily approaches that have been previously conceived or pursued. Therefore, unless otherwise indicated herein, the approaches described in this section are not prior art to the claims in this application and are not admitted to be prior art by inclusion in this section.

**[0003]** As the demand for vehicles continues to grow worldwide, there is an associated rise in pollution and vehicular fatalities due to careless driving. Furthermore, as auto insurance becomes more expensive due to rising number of vehicles, there is no differentiation between insurance expense and coverage for skilled or 'good' drivers and unskilled or 'bad' drivers.

**[0004]** Most modern vehicles collect a large amount of data about vehicle subsystems and vehicle performance, which could be analyzed to help mitigate some of the problems associated with an increasing number of vehicles.

### Summary

**[0005]** Embodiments described herein include a method for generating a driver score. It should be appreciated that the embodiments can be implemented in numerous ways, such as a process, an apparatus, a system, a device, or a method. Several embodiments are described below.

**[0006]** In one embodiment, a method of generating a driver score is disclosed. The method may include an operation to send driving data from a vehicle to a computing device using a

first data collection device such that the driving data includes speed data, acceleration data, transmission data, and engine data. The method may further include an operation to send user data to the computing device using a second data collection device such that the user data includes an age, a gender, and a color of the vehicle. The method may also include an operation to send trip conditions data to the computing device using an external service provider such that the trip conditions data includes a length of a trip, a duration of the trip, a weather condition, and a time of day. The method may include an operation to generate the driver score based on the driving data, the user data, and the trip conditions data using the computing device.

**[0007]** In an embodiment, a method of generating a driver score is disclosed. The method may include an operation to send driving data from a vehicle to a second data collection device using a first data collection device such that the driving data includes speed data, acceleration data, transmission data, and engine data. The method may also include an operation to send the driving data and user data to the computing device using a second data collection device such that the user data includes an age, a gender, and a color of the vehicle. The method may also include an operation to send trip conditions data to the computing device using an external service provider such that the trip conditions data includes a length of a trip, a duration of the trip, a weather condition, and a time of day. The method may include an operation to generate the driver score based on the driving data, the user data, and the trip conditions data using the computing device.

**[0008]** In another embodiment, the method described above may further include an operation to generate environmental impact data based on the driving data, the user data, and the trip conditions data using the computing device such that the environmental impact data includes carbon dioxide emission

data and particulate emission data. The method may further include an operation to generate a green rating based on the environmental impact data using the computing device. The method may include an operation to generate the driver score based on the green rating using the computing device.

**[0009]** In another embodiment, the method described above may further include an operation to generate a route assessment rating based on the trip conditions data and the green rating using the computing device. The method may also include an operation to display the route assessment rating to the user using the computing device.

**[0010]** In yet another embodiment, the method described above may include an operation to generate secondary driving data based on the driving data using the computing device such that the secondary driving data includes braking data, cornering data, and counts of starts and stops data. The method may also include an operation to generate the driver score based on the secondary driving data using the computing device.

**[0011]** In still another embodiment, the method described above may further include an operation to generate an insurance risk rating based on the driving data and the user data using the computing device. The method may also include an operation to generate the driver score based on the insurance risk rating using the computing device.

**[0012]** In another embodiment, the method described above may further include an operation to generate the driver score based on sending or receiving calls on the second communication device using the computing device.

**[0013]** In an embodiment, a system for generating a driver score is disclosed. The system may comprise a first data collection device connected to a vehicle such that the first data collection device receives driving data from the vehicle, the driving data includes speed data, acceleration data, transmission data, and engine data and such that the vehicle

sends the driving data to a second data collection device. The system may also include the second data collection device in communication with a computing device such that the second data collection device receives user data including an age, a gender, and a color of the vehicle. The system may further include an external service provider connected to the computing device such that the external service provider generates trip conditions data including a length of trip, a duration of trip, a weather condition, and a time of day. In the disclosed system the computing device receives the driving data and the user data, and the trip conditions data from the second data collection device and the external service provider respectively. Further, the computing device generates the driver score based on the driving data, the user data, and the trip conditions data.

**[0014]** In an embodiment, an apparatus for generating a driver score is disclosed. The apparatus may include an on-board diagnostics (OBD) device linked to an automobile such that the OBD device receives driving data from the automobile and such that the driving data includes speed data, acceleration data, transmission data, and engine data. The apparatus may also include a smartphone connected to the OBD device such that the smartphone receives user data and such that the user data includes an age, a gender, and a color of the vehicle. The apparatus may further include an external service provider such that the external service provider receives trip conditions data, and such that the trip conditions data includes a length of trip, a duration of trip, a weather condition, and a time of day.

**[0015]** The apparatus may include an application server connected to the automobile, the smartphone, and the external service provider. Further, the application server receives the driving data, the user data, and the trip conditions data from the automobile, the smartphone, and the external service provider

respectively. The application server then generates a driver score based on the driving data, the user data, and the trip conditions data and sends the driver score back to the smartphone.

#### Brief Description of Drawings

**[0016]** In the drawings:

**[0017]** FIG. 1 illustrates an exemplary apparatus for generating a driver score in accordance with an embodiment of the present invention;

**[0018]** FIG. 2 illustrates an exemplary computer system in accordance with an embodiment of present the invention;

**[0019]** FIG. 3 illustrates an exemplary system for generating a driver score in accordance with an embodiment of the present invention;

**[0020]** FIG. 4 illustrates an exemplary method of generating a driver score in accordance with an embodiment of the present invention.

#### Detailed Description of the Drawings

**[0021]** While the concepts of the present disclosure are susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that there is no intent to limit the concepts of the present disclosure to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives consistent with the present disclosure and the appended claims.

**[0022]** In the following description, for the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be apparent, however, that the present invention may

be practiced without these specific details. In other instances, well-known structures and devices are shown in block diagram form in order to avoid unnecessarily obscuring the present invention.

**[0023]** In the drawings, specific arrangements or orderings of schematic elements, such as those representing devices, modules, instruction blocks and data elements, may be shown for ease of description. However, it should be understood by those skilled in the art that the specific ordering or arrangement of the schematic elements in the drawings is not meant to imply that a particular order or sequence of processing, or separation of processes, is required. Further, the inclusion of a schematic element in a drawing is not meant to imply that such element is required in all embodiments or that the features represented by such element may not be included in or combined with other elements in some embodiments.

**[0024]** Further, in the drawings, where connecting elements, such as solid or dashed lines or arrows, are used to illustrate a connection, relationship or association between or among two or more other schematic elements, the absence of any such connecting elements is not meant to imply that no connection, relationship or association can exist. In other words, some connections, relationships or associations between elements may not be shown in the drawings so as not to obscure the disclosure. In addition, for ease of illustration, a single connecting element may be used to represent multiple connections, relationships or associations between elements. For example, where a connecting element represents a communication of signals, data or instructions, it should be understood by those skilled in the art that such element may represent one or multiple signal paths (e.g., a bus), as may be needed, to affect the communication.

**[0025]** Several features are described hereafter that can each be

used independently of one another or with any combination of other features. However, any individual feature may not address any of the problems discussed above or might only address one of the problems discussed above. Some of the problems discussed above might not be fully addressed by any of the features described herein.

**[0026]** The following disclosure discusses an application server generating a driver score in real time for a trip from starting location to destination location in a vehicle using driving data received from the vehicle, user data received from a user or owner of the vehicle, and trip conditions data received from an external service provider. The driver score may be used for a variety of purposes, for example determining environmental impact of the trip, insurance risk associated with the trip, and dangers of driving associated with the trip. The driver score may also be used to generate tips for better or safe driving.

**[0027]** As used herein, "driving data" refers to data associated with driving of the vehicle by the user or owner. For example, driving data may include, average speed, change in speed, engine RPM, and fuel level. The driving data may also include secondary driving data derived from the original driving data, for example, acceleration (based on change in speed over a given period), number of stops on the trip from starting location to destination location (from Global Positioning System (GPS) data), engine idling times (from data points that indicate minimum engine RPM), braking or over-braking (sudden change in speed over a short period), harsh cornering (sudden change in speed accompanied by sudden change in direction of motion of the vehicle), estimated fuel consumed (based on speed, type of vehicle, and engine RPM), estimated pollutants, for example Carbon Di-oxide (CO<sub>2</sub>), generated based on fuel consumed, number of hours driven (from GPS coordinates of vehicle). Driving data and secondary driving data may be based

on data logged previously or may be generated in real-time as vehicle travels from starting location to destination location.

**[0028]** Similarly, "user data" refers to personal data volunteered by user or owner of vehicle. User data may include, age of the user or owner of vehicle, gender of the user, and color of the vehicle. User data may also include starting location (address and/or GPS coordinates) and destination location (address and/or GPS coordinates).

**[0029]** As used herein, "trip conditions data" refers to data related to conditions on the route from starting location to destination location. For example, trip conditions data may include distance from starting location to destination location, weather at starting location or destination location, or along the route from starting location to destination location, traffic updates along the route from starting location to destination location, and time of the day at during the trip from starting location to destination location.

**[0030]** FIG. 1 illustrates an exemplary apparatus for generating a driver score in accordance with an embodiment of the present invention.

**[0031]** Referring now to FIG. 1A, first data collection device 106 is communicatively coupled to vehicle 102 via vehicle bus 104. Vehicle 102 may be a personal or commercial automobile, bus, train, industrial or agricultural vehicle, ship, watercraft, aircraft, and the like. First data collection device 106 may be similar to the computer system 300 described in relation to FIG. 3 below. In another embodiment, first data collection device 106 is an on-board diagnostic (OBD) device for example a generation two OBD (OBD2) device. Vehicle bus 104 is a specialized internal communications network that interconnects components inside vehicle 102. For example, an OBD device may be coupled to a car via a serial cable through

proprietary OBD connectors. Similarly, an OBD2 device may be connected to the car through a standard OBD2 port, for example a Society of Automobile Engineers (SAE) J1962 port, that connects the OBD or OBD2 device to the Controller Area Network (CAN) bus. In an embodiment, first data collection device 106 may be a specialized device such as a hand-held scan tool or a laptop, smartphone, or tablet that can be connected to vehicle 102 through a wired or wireless connection. First data collection device 106 collects driving data related to how vehicle 102 is being driven.

**[0032]** In FIG. 1A, vehicle 102 uses communication module 108 to communicate with computing device 114 via communication link 112A. In an embodiment, communication module 102 may include specialized hardware and circuits to implement communication link 112A through various technologies such as WiFi, Bluetooth, cellular networks (for example, GSM, CDMA, and LTE), infrared, Near-field communication, Ethernet, and Universal Serial Bus (USB). In an embodiment, computing device 114 may be similar to computer system 300 described below in relation to FIG. 3. In another embodiment, computing device 114 may be a specialized cloud based application server or a database server. Supporting a driver score generating application implemented on second data collection device 110. First data collection device 106 collects driving data from vehicle 102 through vehicle bus 104 and transmits the driving data to computing device 114 via communication module 108. For example, a car may send driving data to an application server that is supporting an application implemented on a smartphone via a GSM based cellular network.

**[0033]** Referring again to FIG. 1A, second data collection device 110 is communicatively coupled to computing device 114 via communication link 112B. In an embodiment, second data collection device 110 is similar to computer system 300 described in relation to FIG. 3 below. In another embodiment,

second data collection device 110 is a special purpose hardware executing instructions to collect user data from a user, owner, or driver of a vehicle through a specialized input device. In still another embodiment, second data collection device 110 may send the user data to computing device 114 via communication link 112B. In an embodiment, communication link 112B is similar to communication link 112A described above. In another embodiment, communication link 112B is a dedicated communication channel reserved for communication between second data collection device 110 and computing device 114. For example, a driver score generating application may be implemented on a smartphone and a user may send user data to the application via the touch screen of the smartphone. The application may then transmit the user data to an application server via a GSM based cellular network. In an embodiment, second data collection device 110 sends user data to computing device 114 at the start of a trip in vehicle 102.

**[0034]** In FIG. 1A, computing device 114 is communicatively coupled to external service provider 116 via communication link 112C. In an embodiment, external service provider 116 is similar to computer system 300 described in relation to FIG. 3 below. In another embodiment, external service provider 116 includes a group of cloud-based application servers such that each of the cloud-based application servers provides a subset of the trip conditions data to computing device 114. For example, one cloud-based server may provide data or information relating to weather along the route of vehicle 102 and another cloud-based server may provide traffic data.

**[0035]** Referring now to FIG. 1B, first data collection device 106 receives driving data from vehicle bus 104 of vehicle 102 and transmits the driving data to second data collection device 110 via communication module 108 over communication link 112A. Second data collection device 110 then transmits the driving data along with the user data to computing device

114 through communication link 112B. Thus, instead of communicating directly with computing device 114, first data collection device 106 transmits the driving data to computing device 114 through second data collection device 110. For example, in old cars that do not support communication with an external network due to lack of requisite hardware in communication module 108, the car may communicate the driving data obtained from the CAN bus to a smartphone via Bluetooth or a USB cable. The smartphone then transmits the driving data and user data received from a user to the cloud-based application server via the GSM based network connection.

**[0036]** According to one embodiment, the techniques described herein are implemented by one or more special-purpose computing devices. The special-purpose computing devices may be hard-wired to perform the techniques, or may include digital electronic devices such as one or more application-specific integrated circuits (ASICs), field programmable gate arrays (FPGAs), or other programmable logic devices (PLDs) that are persistently programmed to perform the techniques, or may include one or more general purpose hardware processors programmed to perform the techniques pursuant to program instructions in firmware, memory, other storage, or a combination. Such special-purpose computing devices may also combine custom hard-wired logic, ASICs, or FPGAs with custom programming to accomplish the techniques. The special-purpose computing devices may be desktop computer systems, portable computer systems, handheld devices, networking devices or any other device that incorporates hard-wired and/or program logic to implement the techniques.

**[0037]** For example, FIG. 3 is a block diagram that illustrates a computer system 300 upon which an embodiment of the invention may be implemented. Computer system 300 includes a bus 302 or other communication mechanism for communicating information, and a hardware processor 304 coupled with bus 302 for

processing information. Hardware processor 304 may be, for example, a general purpose microprocessor.

**[0038]** Computer system 300 also includes a main memory 306, such as a random access memory (RAM) or other dynamic storage device, coupled to bus 302 for storing information and instructions to be executed by processor 304. Main memory 306 also may be used for storing temporary variables or other intermediate information during execution of instructions to be executed by processor 304. Such instructions, when stored in non-transitory storage media accessible to processor 304, render computer system 300 into a special-purpose machine that is customized to perform the operations specified in the instructions.

**[0039]** Computer system 200 further includes a read only memory (ROM) 208 or other static storage device coupled to bus 202 for storing static information and instructions for processor 204. A storage device 210, such as a magnetic disk or optical disk, is provided and coupled to bus 202 for storing information and instructions.

**[0040]** Computer system 200 may be coupled via bus 202 to a display 212, such as a cathode ray tube (CRT) Liquid Crystal Display (LCD), Light Emitting Diode (LED), Organic-LED (OLED), or Active-Matrix OLED (AMOLED), for displaying information to a computer user. An input device 214, including alphanumeric and other keys, is coupled to bus 202 for communicating information and command selections to processor 204. Another type of user input device is cursor control 216, such as a mouse, a trackball, or cursor direction keys for communicating direction information and command selections to processor 204 and for controlling cursor movement on display 212. This input device typically has two degrees of freedom in two axes, a first axis (e.g., x) and a second axis (e.g., y), that allows the device to specify positions in a plane. Still another type of input device, such as a capacitive touch

screen or a resistive touch screen may be integrated with display 212.

**[0041]** Computer system 200 may implement the techniques described herein using customized hard-wired logic, one or more ASICs or FPGAs, firmware and/or program logic which in combination with the computer system causes or programs computer system 200 to be a special-purpose machine. According to one embodiment, the techniques herein are performed by computer system 200 in response to processor 204 executing one or more sequences of one or more instructions contained in main memory 206. Such instructions may be read into main memory 206 from another storage medium, such as storage device 210. Execution of the sequences of instructions contained in main memory 206 causes processor 204 to perform the process steps described herein. In alternative embodiments, hard-wired circuitry may be used in place of or in combination with software instructions.

**[0042]** The term "storage media" as used herein refers to any non-transitory media that store data and/or instructions that cause a machine to operation in a specific fashion. Such storage media may comprise non-volatile media and/or volatile media. Non-volatile media includes, for example, optical or magnetic disks, such as storage device 210. Volatile media includes dynamic memory, such as main memory 206. Common forms of storage media include, for example, a floppy disk, a flexible disk, hard disk, solid state drive, magnetic tape, or any other magnetic data storage medium, a CD-ROM, any other optical data storage medium, any physical medium with patterns of holes, a RAM, a PROM, and EPROM, a FLASH-EPROM, NVRAM, any other memory chip or cartridge.

**[0043]** Storage media is distinct from but may be used in conjunction with transmission media. Transmission media participates in transferring information between storage media. For example, transmission media includes coaxial

cables, copper wire and fiber optics, including the wires that comprise bus 202. Transmission media can also take the form of acoustic or light waves, such as those generated during radio-wave and infra-red data communications.

**[0044]** Various forms of media may be involved in carrying one or more sequences of one or more instructions to processor 204 for execution. For example, the instructions may initially be carried on a magnetic disk or solid state drive of a remote computer. The remote computer can load the instructions into its dynamic memory and send the instructions over a telephone line using a modem. A modem local to computer system 200 can receive the data on the telephone line and use an infra-red transmitter to convert the data to an infra-red signal. An infra-red detector can receive the data carried in the infra-red signal and appropriate circuitry can place the data on bus 202. Bus 202 carries the data to main memory 206, from which processor 204 retrieves and executes the instructions. The instructions received by main memory 206 may optionally be stored on storage device 210 either before or after execution by processor 204.

**[0045]** Computer system 200 also includes a communication interface 218 coupled to bus 202. Communication interface 218 provides a two-way data communication coupling to a network link 220 that is connected to a local network 222. For example, communication interface 218 may be an integrated services digital network (ISDN) card, cable modem, satellite modem, or a modem to provide a data communication connection to a corresponding type of telephone line. As another example, communication interface 218 may be a local area network (LAN) card to provide a data communication connection to a compatible LAN. Wireless links may also be implemented. In any such implementation, communication interface 218 sends and receives electrical, electromagnetic or optical signals that carry digital data streams representing various types of

information. For example, wireless links may be implemented through use of networking technologies like WiFi, Bluetooth, infrared, and Near-Field Communication (NFC) among others.

**[0046]** Network link 220 typically provides data communication through one or more networks to other data devices. For example, network link 220 may provide a connection through local network 222 to a host computer 224 or to data equipment operated by an Internet Service Provider (ISP) 226. ISP 226 in turn provides data communication services through the world wide packet data communication network now commonly referred to as the "Internet" 228. Local network 222 and Internet 228 both use electrical, electromagnetic or optical signals that carry digital data streams. The signals through the various networks and the signals on network link 220 and through communication interface 218, which carry the digital data to and from computer system 200, are example forms of transmission media.

**[0047]** Computer system 200 can send messages and receive data, including program code, through the network(s), network link 220 and communication interface 218. In the Internet example, a server 230 might transmit a requested code for an application program through Internet 228, ISP 226, local network 222 and communication interface 218.

**[0048]** The received code may be executed by processor 204 as it is received, and/or stored in storage device 210, or other non-volatile storage for later execution.

**[0049]** FIG. 3 illustrates an exemplary system for generating a driver score in accordance with an embodiment of the present invention. For the purposes of illustrating clear examples, FIG. 3 will be discussed in relation to FIG. 1 and FIG. 2.

**[0050]** Referring now to FIG. 3, the system may include one or more sub-modules on application/applets executing different functions that are implemented on one or more computing devices. In an embodiment, the system may include consumer

driver score application 302 implemented on second data collection device 110, server driver score application 308 implemented on computing device 114, and third-party data collection application 314 implemented on external service provider 116. In an embodiment, consumer driver score application 302 communicates with server driver score application 308 via communication link 112B as described above. In an embodiment, server driver score application 308 communicates with third-party data collection application 314 via communication link 112C as described above.

**[0051]** In Fig. 3, consumer drive score application 302 may further include driver data collection module 304 and user data collection module 306. In an embodiment, driver data collection module 304 receives and stores the driving data from first data collection device 106. In another embodiment, driver data is directly transmitted from vehicle 102 to computing device 114. In an embodiment, driving data may include average speed, engine RPM, fuel consumption, over braking, harsh braking, harsh cornering, rapid acceleration, number of starts and stops, among others. For example, driving data for a car on a trip from starting location to destination location may include average speed of 40 kilometers per hour, engine RPM of 6000-8000, 10 incidents of harsh braking, 10 incidents of harsh cornering, 5 incidents of rapid acceleration, 6 stops, and 7 minutes engine idling.

**[0052]** In an embodiment, user data collection module 306 receives user data from a user. In an embodiment, the user is an owner or a driver of vehicle 102. In an embodiment, user data collection module 306 includes a GUI interface that enables the user to create a user account to use consumer driver score application 302. In an embodiment, during the process of account creation, user data collection module 306 prompts the user to enter user data for example, name, age, gender, date of birth, and color of vehicle 102 to be driven

by user. In an embodiment, certain attributes maybe required for account creation. For example, in one implementation name, gender, and color of car may be required for account creation and use of consumer driver score application.

**[0053]** Further, user data collection module 306 links the user data to the user account and transmits the user data and user account information to server driver score application 308. In another embodiment, if the driving data is available from driver data collection module 304, then consumer driver score application 302 appends the driving data to the user data and sends the appended data to server driver score application 308. In an embodiment, the user data includes starting location and destination location entered by the user. For example, a user named 'Jon,' may create a user account on consumer driver score application 302 executing on a smartphone as a smartphone application. During the course of account creation, Jon may enter information using the smartphone touchscreen including his age as 'twenty five,' gender as 'male,' and color of his car as 'black'. He may also include his starting location as 'Building X, Street Y, Town Z' and destination location as 'Building A, Street B, Town C.' This information may be linked to his account by the smartphone app and transmitted to server driver score application 308. In an embodiment, the user data is appended to the driving data for that user and the appended data is transmitted to server driver score application 308.

**[0054]** Referring again to FIG. 3, third-party data collection application 314 collects trip conditions data from external service provider 116 and communicates the trip conditions data to server driver score application 308. In an embodiment, the trip conditions data may be received from a variety of external service providers. In an embodiment, third-party data collection application 314 receives the starting location and destination location from server driver score application 308.

In an embodiment, third-party data collection application 314 collects data related to suggested routes between starting location and destination location from external service providers. In an embodiment, the trip conditions data is dependent upon a suggested route from starting location and the destination location. For example, weather information regarding temperature, precipitation, humidity, smog, wind speed, weather hazards and the like will depend upon the route between starting location and destination location. Similarly, traffic conditions data will depend on the route and the time of the day.

**[0055]** Referring again to FIG. 3, server driver score application 308 may include database module 310 and analysis module 312. Database module 310 may be implemented as a commercially available database (DB) solution. For example, database module 310 may be implemented as a database management system (DBMS). DBMS maybe a computer software application that interacts with the user, other applications, and the database itself to capture and analyze data. A general-purpose DBMS is designed to allow the definition, creation, querying, update, and administration of databases. Well-known DBMSs include MySQL, PostgreSQL, MongoDB, MariaDB, Microsoft Structured Query Language (SQL) Server, Oracle, Sybase, SAP HANA, MemSQL and IBM DB2. A database is not generally portable across different DBMSs, but different DBMS can interoperate by using standards such as SQL and Open Database Connectivity (ODBC) or Java Database Connectivity (JDBC) to allow a single application to work with more than one DBMS. In an embodiment, database module 310 is implemented as a relational database.

**[0056]** In an embodiment, database module 310 stores driving data and user data received from consumer driver score application 302. In another embodiment, database module 310 appends and stores driver data received from vehicle 102 and user data

received from second data collection device 106. In an embodiment, database module 310 links driving data and user data to user account information received from consumer driver score application 302. Data module 310 may also support versioning and store different versions of driver data received over different periods of time. In an embodiment database module 310 receives trip conditions data from third-party data collection application 314. In an embodiment, database module 310 communicates the driving data, the user data, and the trip conditions data to analysis module 312.

**[0057]** In FIG. 3, analysis module 312 generates a driver score based on the driving data, the user data, and the trip conditions data received from database module 312. Analysis module 312 may communicate the driver score back to database module 310, which may then send the driver score back to consumer driver score application 302 implemented on second data collection device 110 to be displayed to the user. For example, analysis module 312 may receive the following information from database module 310 for a user:

Name: Jon

Gender: Male

Color of Car: Black

Starting location: Building X, Street Y, Town Z

(Corresponding to GPS coordinates La<sub>1</sub>, La<sub>2</sub> and Lo<sub>1</sub>, Lo<sub>2</sub>)

Destination location: Building A, Street B, Town C

(Corresponding to GPS coordinates La<sub>3</sub>, La<sub>4</sub> and Lo<sub>1</sub>, Lo<sub>2</sub>)

Time of day: 8:00 PM

Weather: 24 degrees Celsius, Clear skies, 7

Kilometers/Hour North-Easterly wind

Traffic conditions: Light traffic on suggested route

Real-time speed: 80 Kilometers/Hour

Real-time engine RPM: 6000-8000

Real-time harsh-braking count: 5

Real-time speeding violations: 2

Analysis module 312 generates a driver score by assigning different weights, corresponding to driving risk as evaluated by analysis module 312, to different data points and generating a numerical value based on the weights. For example, a black car being driven at night may be weighted as higher risk and may negatively impact the driver score. Similarly, high speeds or harsh braking in inclement weather may be weighted as higher driving risk and negatively impact the driver score. In an embodiment, the driver score is a numerical value between zero and one hundred. For example, based on the data in the example above and assignment of weights by analysis module 312, Jon may have a driver score of 60. In an embodiment, driver scores are classified as good, average, or poor based on the range of numerical value on a scale from zero to one hundred. For example, a driver score from zero to forty may be classified as poor, a driver score of forty one to eighty may be classified as average, and driver score of eighty one to one hundred may be classified as good. Other embodiments may use other ranges and classifications.

**[0058]** In an embodiment, the driving score is updated in real time as analysis module 312 receives updated real-time driving data from database module 310. In an embodiment, driver score is updated at the end of a trip from starting location to destination location. In an embodiment, analysis module 312 is pre-programmed with risk weights pertaining to different combinations of various user data, driving data, and trip conditions data. In an embodiment, analysis module 312 adjusts the risk weights pertaining to different combinations of various user data, driving data, and trip conditions data by using machine learning techniques on the large dataset of user data and driving data for different users stored in database module 310.

**[0059]** In an embodiment, the driving score may be based upon the

using a cellphone or a smartphone to send or receive calls in vehicle 102. A high number of calls sent or received may indicate that the user was distracted while driving vehicle 102 and may therefore be a danger to himself/herself and other drivers. For example, a user or driver may connect his phone to a car's Bluetooth system and send or receive calls on the phone. In an embodiment, if the total number of received and sent calls exceeds a pre-determined threshold value, the user's driver score is negatively impacted. In an embodiment, the value is determined using analysis module 302. In another embodiment, if the total time spent making or receiving calls exceeds a pre-determined value, the user's driver score is negatively impacted.

**[0060]** The driver score generated by analysis module 312 may be used to determine a user or driver's insurance risk as evaluated by insurance providers. Typically, driver's insurance risk is defined as the probability that a particular driver or user would be involved in an incident that results in an insurance payout. Driver's insurance risk is usually dependent upon type of vehicle used, measured against time, distance, driving behavior and place. Since, analysis module 312 generates a driver score based on similar data points, a higher driver score over a period of time may indicate that a user is a 'safe driver' and the user's premiums may be lowered accordingly. Similarly, consistently poor driving scores may indicate that the user is an 'unsafe driver' and their premiums may consequently increase. In an embodiment, analysis module 312 may generate a separate insurance risk rating based on the driver's insurance risk.

**[0061]** The driver score may also be used to generate safety tips and/or good driving tips for a user. For example, a user may receive a driver score on their smartphone while driving. If the driver score is low because the user is constantly speeding and therefore has a high number of speeding

violations, the user's smartphone (i.e. second data collection device 110) may flash a text or an audio-visual alert on the smartphone's display suggesting the user should slow down. Similarly, second data collection device 110 may display a series of tips for improving driving and driving data related metrics based on the driver score to the user.

**[0062]** The driver score may also be used to reduce a user's carbon footprint. For example, analysis module 312 may suggest different routes based on the estimated amount of fuel to be used on a trip between the starting and destination locations of each route. Similarly, analysis module 312 may generate a green rating or an environmental rating (calculated based on certain driving and trip condition data points for example, estimated fuel consumption, historical driving speeds, and estimated engine idling time among others) that is displayed separately to the user at the end of each trip. In an embodiment, analysis module 312 may also provide environmental friendly driving tips in accordance with the green rating.

**[0063]** In an embodiment, a driver score generated by analysis module 312 may be used for parental oversight of new or young drivers. For example, parents may limit the driving of vehicle 102 by young or new drivers based on negative or low driver scores. In an embodiment, parents may electronically lock vehicle 102 to prevent drivers with low driver scores from driving vehicle 102. In an embodiment, the data used to generate the driver score may also be used to enable geo-fencing and restricting children from straying outside pre-defined boundaries while driving vehicle 102.

**[0064]** In an embodiment, a driver score generated by analysis module 312 may be used for management of fleet vehicles. For example, a taxi operator may use driver scores to determine which taxis and taxi drivers should be allowed to ply on roads. In an embodiment, the driver score is used to observe fleet vehicles in real time. For example, dairy trucks or

taxis can be observed in real time to ensure that the drivers are following pre-determined quality parameters. In an embodiment, analysis module 312 may rely on additional data like state of cargo and delivery efficiency among others to calculate driver scores for drivers operating vehicles from a fleet of vehicles. In an another embodiment, analysis module 312 may also provide access to the additional data to fleet operators. For example, for dairy truck drivers would be able to observe temperature of cargo in the truck.

**[0065]** FIG. 4 illustrates an exemplary method of generating a driver score in accordance with an embodiment of the present invention. For the purposes of illustrating clear examples, FIG. 4 will be discussed in relation to FIG. 1, FIG.2, and FIG. 3.

**[0066]** Referring now to FIG. 4, at step 402 a user who is an owner/driver of vehicle 102 may decide to travel from a starting location to a destination location. The user may initiate or launch consumer driver score application 302 implemented on second data collection device 110. For example, a user may get into their car to drive from a starting location to a destination location and launch a driver score generating application on their smartphone. In response, first data collection device 106 sends driving data from vehicle 102 to computing device 114. In an embodiment, first collection device 106 receives driving data from vehicle 102 via an OBD port that links to the CAN bus or vehicle bus. In an embodiment, first data collection device 106 sends the driving data via communication module 108. In an embodiment, the driving data is recorded by first data collection device 106 and transmitted from vehicle 102 to computing device 114 in real-time. For example, an OBD2 handheld scanner may record the driving data and send the driving data to a cloud-based application server that is supporting the driver score application operating on the user's smartphone using a GSM

based cellular network. In an embodiment, the driving data is first transmitted to second data collection device 110, which then sends the driving data to computing device 114. For example, the OBD2 device, which is also interfaced with the user's smartphone over a Bluetooth link or through a USB cable, sends the driving data to the smartphone and the smartphone then sends the driving data to the cloud-based application server via the GSM based cellular network.

**[0067]** At step 404, second data collection device 110 collects user data from user and sends the user data to computing device 114 via communication link 112B. In an embodiment, the user data is input to consumer driver score application 302 implemented on second data collection device 110. For example, user data, like age of user, gender of user, and color of vehicle 102, may be input-into the user's smartphone by the user. In an embodiment, the driver score application on the smartphone may require user to create an account.

**[0068]** At step 406, external service provider 116 sends trip conditions data to computing device 114 via communication link 112C. In an embodiment, the trip conditions data may be collected by third-party data collection application 314 implemented on external service provider 116. In an embodiment, external service provider 116 receives a starting location and an ending location prior to sending the trip conditions data to computing device 114. For example, the cloud-based application server may receive data relating to weather, traffic, and other trip conditions from a website like Google.com™ or Yahoo.com™.

**[0069]** At step 408, computing device 114 generates a driver score based on the received user data, driving data, and trip conditions data. In an embodiment, server driver score application 308 implemented on computing device 114 generates the driving score. In an embodiment, database module 310 of server driver score application 308 implemented on computing

device 114 may also store the user data and driving data associated with a user (through a user account). In an embodiment, analysis module 312 of server driver score application 308 implemented on computing device 114 generates the driver score based on the user data, the driving data, and the trip conditions. In an embodiment, the driver score generated by analysis module 312 is a numerical value. Continuing the example in the previous steps, the cloud-based application server may have an internal database to store user account information, user data, and driving data and a risk analytics engine that generates the driver score based on the user data, driving data, and trip conditions data. In an embodiment, the driver score is generated in real-time. In an embodiment, the driver score is updated in real-time based on updated driving data. In an embodiment, driving data is appended to subsidiary data for example, green rating, and safe driving tips that are generated based on the driver score.

**[0070]** At step 410, computing device 114 sends the driver score to second data collection device 110. For example, the user may receive a driver score on their smartphone screen along with safe driving tips. In an embodiment, the user receives a cumulative driver score at the end of their trip from starting location to destination location on second data collection device 110.

**[0071]** In the foregoing specification, embodiments of the invention have been described with reference to numerous specific details that may vary from implementation to implementation. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense. The sole and exclusive indicator of the scope of the invention, and what is intended by the applicants to be the scope of the invention, is the literal and equivalent scope of the set of claims that issue from this

application, in the specific form in which such claims issue, including any subsequent correction. Any definitions expressly set forth herein for terms contained in such claims shall govern the meaning of such terms as used in the claims.

What is claimed is:

1. A method of generating a driver score comprising:  
sending driving data from a vehicle to a computing device  
using a first data collection device, wherein the  
driving data comprises speed data, acceleration  
data, transmission data, and engine data;  
sending user data to the computing device using a second  
data collection device, wherein the user data  
comprises an age, a gender, and a color of the  
vehicle;  
sending trip conditions data to the computing device  
using an external service provider, wherein the trip  
conditions data comprises a length of a trip, a  
duration of the trip, a weather condition, and a  
time of day; and  
generating the driver score based on the driving data,  
the user data, and the trip conditions data using  
the computing device.
2. A method of generating a driver score comprising:  
sending driving data from a vehicle to a second data  
collection device using a first data collection  
device, wherein the driving data comprises speed  
data, acceleration data, transmission data, and  
engine data;  
sending the driving data and user data to a computing  
device using a second data collection device,  
wherein the user data comprises an age, a gender,  
and a color of the vehicle;  
sending trip conditions data to the computing device  
using an external service provider, wherein the trip  
conditions data comprises a length of a trip, a  
duration of the trip, a weather condition, and a

time of day; and  
generating the driver score based on the driving data,  
the user data, and the trip conditions data using  
the computing device.

3. The method as defined in claim 1 or claim 2 further comprising:  
sending the driver score to the second data collection  
device using the computing device.
4. The method as defined in claim 1 or claim 2 further comprising:  
generating environmental impact data based on the driving  
data, the user data, and the trip conditions data  
using the computing device, wherein the  
environmental impact data comprises carbon dioxide  
emission data and particulate emission data;  
generating a green rating based on the environmental  
impact data using the computing device; and  
sending the green rating to the second data collection  
device using the computing device.
5. The method as defined in claim 4, wherein generating the  
driver score further comprises:  
generating a route assessment rating based on the trip  
conditions data and the green rating using the  
computing device; and  
sending the routing assessment to the second data  
collection device using the computing device.
6. The method as defined in claim 1 or claim 2 further comprising:  
generating secondary driving data based on the driving  
data using the computing device, wherein the

secondary driving data comprises braking data, cornering data, and counts of starts and stops data; and  
generating the driver score based on the secondary driving data using the computing device.

7. The method as defined in claim 1 or claim 2 further comprising:  
generating an insurance risk rating based on the driving data, the user data, and the trip conditions data using the computing device, wherein the insurance risk data quantifies an insurance risk value associated with the trip; and  
sending the insurance risk rating to the second data collection device using the computing device.
8. The method as defined in claim 1 or claim 2, wherein the first data collection device comprises one of a group consisting: an on-board diagnostic device, a smartphone, a laptop, a personal digital assistant, or a tablet.
9. The method as defined in claim 1, 2, or 8, wherein the first data collection device is communicatively coupled to the vehicle via an on-board diagnostic device port.
10. The method as defined in claim 1, wherein the first data collection device is connected to the computing device via a communication module comprising specialized components pertaining to at least one of a group of technologies consisting: WiFi, Bluetooth, infrared, Universal Serial Bus, Global System for Mobile Communication (GSM) and Ethernet cable.

11. The method as defined in claim 1 or claim 2, wherein the second data collection device is at least one of a group consisting: a smartphone, a laptop, a personal digital assistant (PDA), or a tablet.
12. The method as defined in claim 1 or claim 2, wherein the second data collection device is connected to the computing device via a communication link, and wherein the communication link is established based on at least one of a group of technologies consisting: WiFi, Bluetooth, infrared, Universal Serial Bus, and Ethernet.
13. The method as defined in claim 1 or claim 2 further comprising:  
creating a user account on a drive score generating application executing on the second data collection device; and  
entering the user data on the drive score generating application using the second data collection device.
14. The method as defined in claim 1 or claim 2 further comprising:  
sending a starting location from the second data collection device to the external service provider;  
and  
sending a destination location from the second data collection device to the external service provider.
15. The method as defined in claim 14, wherein the trip conditions data is automatically generated by the external service provider based on the starting location and the destination location.

16. The method as defined in claim 1 or claim 2, further comprising:  
generating driver safety tips based on the driver score  
using the computing device; and  
sending the driver safety tips to the second data  
collection device.
17. The method as defined in claim 1 or claim 2, wherein the  
computing device comprises one of a group consisting: a  
smartphone, a laptop, a database server, a cloud-based  
application server, a personal digital assistant (PDA),  
or a tablet.
18. The method as defined in claim 1 or claim 2, wherein the  
driver score is determined using the computing device  
based on sending or receiving calls using the second  
communication device.
19. An apparatus for generating a driver score comprising:  
a first data collection device communicatively coupled to  
a vehicle, wherein the first data collection device  
sends driving data from the vehicle comprising speed  
data, acceleration data, transmission data, and  
engine data to the ;  
a second data collection device communicatively coupled  
to the vehicle and a computing device, wherein the  
second data collection device:  
receives driving data from the vehicle;  
collects user data comprising an age, a gender, and  
a color of the vehicle;  
sends the driving data and the user data to the  
computing device;  
an external service provider communicatively coupled to  
the computing device wherein the external service

provider:

generates trip conditions data comprising a length of trip, a duration of trip, a weather condition, and a time of day;

sends the trip conditions data to the computing device; and

a computing device communicatively coupled to the second data collection device and the external service provider generates the driver score based on the driving data, the user data, and the trip conditions data.

20. A system for generating a driver score comprising:

a first data collection device communicatively coupled to a vehicle, wherein the first data collection device receives driving data from the vehicle, wherein the driving data comprises speed data, acceleration data, transmission data, and engine data, and wherein the vehicle sends the driving data to a second data collection device;

the second data collection device communicatively coupled to a computing device, wherein the second data collection device receives user data comprising an age, a gender, and a color of the vehicle;

an external service provider communicatively coupled to the computing device wherein the external service provider generates trip conditions data comprising a length of trip, a duration of trip, a weather condition, and a time of day; and

wherein the computing device receives the driving data and the user data, and the trip conditions data from the second data collection device and the external service provider respectively, and wherein the computing device generates the driver score based on

the driving data, the user data, and the trip conditions data.

21. An apparatus for generating a driver score comprising:  
an on-board diagnostics (OBD) device communicatively coupled to an automobile, wherein the OBD device receives driving data;  
a smartphone communicatively coupled to the OBD device, wherein the smartphone receives user data;  
an external service provider, wherein the external service provider receives trip conditions data; and  
an application server communicatively coupled to the automobile, the smartphone, and the external service provider, wherein the application server receives the driving data, the user data, and the trip conditions data from the automobile, the smartphone, and the external service provider respectively, wherein the application server generates the driver score based on the driving data, the user data, and the trip conditions data, and wherein the application server sends the driver score to the smartphone.