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SYSTEM AND METHOD FOR GENERATING DATA REGARDING A VEHICLE CRASH

Abstract

A computer-implemented method for generating data regarding a vehicle crash of a vehicle can include receiving, using one or more processors of a mobile computing device within the vehicle, initial sensor data, and determining, using the one or more processors, that the initial sensor data includes sensor data indicating that the vehicle crash has occurred. The method also can include, in response to the determining, receiving additional sensor data for a first amount of time; and generating, using the one or more processors, combined sensor data that (i) is based on the initial sensor data and the additional sensor data and (ii) includes first sensor data corresponding to a first period of time before the vehicle crash of the vehicle and second sensor data corresponding to a second period of time after the vehicle crash of the vehicle. Other embodiments are disclosed.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION [0001] The present application is a continuation of U.S. application Ser. No. 19/062,906 "System and Method for Generating Data Regarding a Vehicle Crash," filed Feb. 25, 2025, which is a continuation of U.S. application Ser. No. 18/232,034 "System and Method for Generating Data Regarding a Vehicle Crash," filed Aug. 9, 2023, issued as U.S. Pat. No. 12,243,363; and which is a continuation of U.S. application Ser. No. 17/553,019 entitled "System and Method for Generating Data Regarding a Vehicle Crash," filed Dec. 16, 2021, issued as U.S. Pat. No. 11,756,354; and which is a continuation of U.S. application Ser. No. 16/949,097 entitled "System and Method for Generating Data Regarding a Vehicle Crash," filed Oct. 13, 2020, issued as U.S. Pat. No. 11,238,678; and which is a continuation of U.S. application Ser. No. 15/199,156, entitled "System and Method for Generating Data Regarding a Vehicle Crash," filed Jun. 30, 2016, issued as U.S. Pat. No. 10,832,504; and which claims priority to U.S. Provisional Patent Application No. 62/326,408, entitled "System and Method for Generating Data Regarding a Vehicle Crash," filed on Apr. 22, 2016, the disclosures of each of which are hereby incorporated herein by reference.

FIELD OF THE DISCLOSURE
[0002] The present disclosure generally relates to vehicle crash data and, more particularly, to a system and method for generating data regarding a vehicle crash.
BACKGROUND
[0003] A vehicle may include one or more sensors that may be a part of a computing device or operate in conjunction with a computing device to facilitate crash detection when the vehicle is traveling. In some cases, the computing device may be a smart phone and the one or more sensors may operate in conjunction with an app installed and executing on the smart phone to facilitate crash detection. However, current uses of sensors and apps to detect vehicle crashes have several drawbacks.
SUMMARY
[0004] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the

scope of the claimed subject matter.

[0005] In one aspect, a computer-implemented method for generating data regarding a vehicle crash includes: (i) receiving, using one or more processors of a mobile computing device within a vehicle, initial sensor data indicating that a vehicle crash has occurred, and additional sensor data for a first amount of time; and (ii) generating, using the one or more processors, combined sensor data that includes first sensor data corresponding to a period of time before the crash of the vehicle and second sensor data corresponding to a period of time after the crash of the vehicle.

[0006] In another aspect, a computing device for generating data regarding a vehicle crash includes one or more processors; and one or more memories coupled to the one or more processors, the one or more memories including non-transitory computer executable instructions stored therein that, when executed by the one or more processors, cause the one or more processors to: (i) receive initial sensor data via the one or more processors indicating that a vehicle crash has occurred, and additional sensor data for a first amount of time; and (ii) generate, using the one or more processors, combined sensor data that includes first sensor data corresponding to a period of time before the crash of the vehicle and second sensor data corresponding to a period of time after the crash of the vehicle.

[0007] In yet another aspect, a computer readable storage medium includes non-transitory computer readable instructions stored thereon for generating data regarding a vehicle crash, wherein the instructions when executed on one or more processors cause the one or more processors to: (i) receive initial sensor data via the one or more processors indicating that a vehicle crash has occurred, and additional sensor data for a first amount of time; and (ii) generate, using the one or more processors, combined sensor data that includes first sensor data corresponding to a period of time before the crash of the vehicle and second sensor data corresponding to a period of time after the crash of the vehicle.

[0008] In a further aspect, a computer-implemented method for generating data regarding a vehicle crash of a vehicle can include receiving, using one or more processors of a mobile computing device within the vehicle, initial sensor data, and determining, using the one or more processors, that the initial sensor data includes sensor data indicating that the vehicle crash has occurred. The method also can include, in response to the determining, receiving additional sensor data for a first amount of time; and generating, using the one or more processors, combined sensor data that (i) is based on the initial sensor data and the additional sensor data and (ii) includes first sensor data corresponding to a first period of time before the vehicle crash of the vehicle and second sensor data corresponding to a second period of time after the vehicle crash of the vehicle.

[0009] In yet a further aspect, a computing device for generating data regarding a vehicle crash of a vehicle, the computing device can include: one or more processors; and one or more memories coupled to the one or more processors. The one or more memories can include non-transitory computer executable instructions stored therein that, when executed by the one or more processors, cause the one or more processors to receive initial sensor data via the one or more processors, and determine, using the one or more processors, that the initial sensor data includes sensor data indicating that the vehicle crash of the vehicle has occurred. The non-transitory computer executable instructions, when executed by the one or more processors, can further cause the one or more processors to, in response to the determining, receive additional sensor data for a first amount of time, and generate, using the one or more processors, combined sensor data that (i) is based on the initial sensor data and the additional sensor data and (ii) includes first sensor data corresponding to a first period of time before the vehicle crash of the vehicle and second sensor data corresponding to a second period of time after the vehicle crash of the vehicle.

[0010] In still yet a further aspect, a computer readable storage medium can include non-transitory computer readable instructions stored thereon for generating data regarding a vehicle crash of a vehicle. The non-transitory computer readable instructions, when executed on one or more processors, can cause the one or more processors to receive initial sensor data via the one or more

processors, and determine, using the one or more processors, that the initial sensor data includes sensor data indicating that the vehicle crash has occurred. The non-transitory computer readable instructions, when executed on one or more processors, can further cause the one or more processors to, in response to the determining, receive additional sensor data for a first amount of time, and generate, using the one or more processors, combined sensor data that (i) is based on the initial sensor data and the additional sensor data and (ii) includes first sensor data corresponding to a first period of time before the vehicle crash of the vehicle and second sensor data corresponding to a second period of time after the vehicle crash of the vehicle.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The figures described below depict various aspects of the system and methods disclosed herein. It should be understood that each figure depicts an embodiment of a particular aspect of the disclosed system and methods, and that each of the figures is intended to accord with a possible embodiment thereof. Further, wherever possible, the following description refers to the reference numerals included in the following figures, in which features depicted in multiple figures are designated with consistent reference numerals.

[0012] FIG. **1** illustrates an example system for generating vehicle crash data;

[0013] FIG. **2** illustrates an example computing device that may be an implementation of one or more computing devices described elsewhere herein, and illustrates components thereof;

[0014] FIG. **3** is a flow chart of an example method, routine, or process for generating an indication of whether a vehicle crash has occurred;

[0015] FIG. **4** is a flow chart of an example method, routine, or process for providing post-crash information after an indication that a vehicle crash has occurred;

[0016] FIG. **5** illustrates the example system of FIG. **1** for generating vehicle crash data in greater detail;

[0017] FIG. **6** is a flow chart of an example method, routine, or process for generating vehicle crash data;

[0018] FIG. **7** is a flow chart of another example method, routine, or process for generating vehicle crash data;

[0019] FIG. **8** illustrates an implementation of the example computing device of FIG. **2** and components thereof that may be used in generating data regarding a vehicle crash; and

[0020] FIG. **9** is a flow chart of an example method, routine, or process for generating data regarding a vehicle crash.

[0021] The figures depict various aspects of the present invention for purposes of illustration only. One skilled in the art will readily recognize from the following discussion that alternative embodiments of the structures and methods illustrated herein may be employed without departing from the principles of the invention described herein.

DETAILED DESCRIPTION

[0022] Although the following text sets forth a detailed description of numerous different embodiments, it should be understood that the legal scope of the description is defined by the words of the claims set forth at the end of this patent and equivalents. The detailed description is to be construed as exemplary only and does not describe every possible embodiment since describing every possible embodiment would be impractical. Numerous alternative embodiments could be implemented, using either current technology or technology developed after the filing date of this patent, which would still fall within the scope of the claims.

[0023] It should also be understood that, unless a term is expressly defined in this patent using the sentence "As used herein, the term '_____' is hereby defined to mean . . . " or a similar sentence,

there is no intent to limit the meaning of that term, either expressly or by implication, beyond its plain or ordinary meaning, and such term should not be interpreted to be limited in scope based on any statement made in any section of this patent (other than the language of the claims). To the extent that any term recited in the claims at the end of this patent is referred to in this patent in a manner consistent with a single meaning, that is done for sake of clarity only so as to not confuse the reader, and it is not intended that such claim term be limited, by implication or otherwise, to that single meaning. Finally, unless a claim element is defined by reciting the word "means" and a function without the recital of any structure, it is not intended that the scope of any claim element be interpreted based on the application of 35 U.S.C. § 112 (f).

I. Example System and Related Functionality

[0024] FIG. **1** illustrates an example system **100** for generating vehicle crash data, such as an indication of whether a vehicle crash has occurred. The example system **100** may include a vehicle **102** (only a portion of which is shown in FIG. **1** for ease of illustration and explanation), a computer network **104**, a remote computing device(s) **106**, a database **108** or other data storage mechanism (e.g., one or more hard disk drives, optical storage drives, solid state storage devices, etc.), and call management device(s) **110**. As shown in FIG. **1** and described in further detail below, each of the vehicle **102**, the remote computing device(s) **106**, the database **108**, and the call management device(s) **110** may be communicatively coupled to the computer network **104**. In other embodiments, various ones of the elements of the example system **100** may be communicatively coupled to one another in a manner other than via the computer network **104**. By way of example, the remote computing device(s) **106** may be directly coupled to the call management device(s) **110** through a dedicated wired or wireless link (as shown in FIG. **1**), and/or may be directly coupled to the database **108** through a dedicated wired or wireless link (not shown in FIG. **1**). As in other examples shown and described herein, singular and/or plural instances of various elements may be shown and described as such for case of illustration and explanation. Thus, for example, the example system **100** may include a number of vehicles **102** with parties therein that are insured by an insurance provider, and any suitable number of remote computing device(s) **106**, databases **108**, and call management device(s) **110**.

[0025] The computer network **104** may be a computer network of an insurance provider (e.g., provided or used by the insurance provider, or communications over which the insurance provider otherwise controls or facilitates). In various embodiments, as further described below, processors of the remote computing device(s) **106**, the call management device(s) **110**, and/or devices in the vehicle **102** may execute instructions to transmit data to, receive data from, or otherwise communicate with one another and/or the database **108**, for example, via the computer network **104**. The computer network **104** may be or may include a network such as the Internet and/or any other type of suitable network (e.g., a local area network (LAN), a metropolitan area network (MAN), a wide area network (WAN), a mobile network, a wired or wireless network, a private network, a virtual private network, etc.). The computer network **104** may also or alternatively be or include one or more cellular networks such as code division multiple access (CDMA) network, GSM (Global System for Mobile Communications) network, WiMAX (Worldwide Interoperability for Microwave Access) network, Long Term Evolution (LTE) network, etc.

[0026] As shown in the example system **100**, the vehicle **102** includes a driver **112** seated in a driver seat **114** and associated with (e.g., owning and/or possessing) a first mobile computing device **116**, such as a smart phone. The vehicle **102** may also include a front passenger **118** seated in a front passenger seat **120** and associated with a second mobile computing device **122**, such as another smart phone. While various examples herein describe computing devices such as the first mobile computing device **116** and/or the second mobile computing device **122** as smart phones, it will be understood by one of ordinary skill in the art in light of the teaching and disclosure herein that each of the computing devices referred to herein may be any suitable computing device. For example, each of the computing devices referred to herein may be implemented as a desktop

computer, a laptop computer, a mobile phone such as a smart phone, a tablet, a phablet, smart glasses, other wearable computing device(s), etc.

[0027] As further described below, the remote computing device(s) **106** (e.g., an insurance provider server(s)) and/or a device(s) in the vehicle **102**, such as the first mobile computing device **116** and/or the second mobile computing device **122**, may be used in generating an indication of whether a vehicle crash has occurred, such as a crash of the vehicle **102**. In various embodiments, as further described below, the first mobile computing device **116** and/or the second mobile computing device **122**, for example, may include one or more sensors that may output sensor data indicative of whether a crash of the vehicle **102** has occurred. For example, each of the first mobile computing device **116** and the second mobile computing device **122** may include one or more of an accelerometer, a pressure sensor (e.g., a barometric pressure sensor), a gyroscope, a magnetometer, or a sound monitoring component (e.g., a microphone or other suitable sound monitoring component). In some embodiments, as further described below, the one or more sensors may output sensor data indicating that a condition corresponding to a crash of the vehicle **102** has occurred (e.g., indicating that an amount of acceleration corresponding to a crash of the vehicle **102** has been sensed), and further sensor data may then be output and used to generate an indication of whether the crash of the vehicle **102** has occurred.

[0028] The first mobile computing device **116**, the second mobile computing device **122**, and/or the remote computing device(s) **106** may also or alternatively be used in generating, for example, an indication of a severity of the crash of the vehicle **102**, a location of the vehicle **102** at a time of the crash of the vehicle **102**, the time of the crash of the vehicle **102**, a speed of the vehicle **102** at the time of the crash of the vehicle **102**, a number of occupants of the vehicle **102** at the time of the crash of the vehicle **102**, and/or a Delta-V associated with the crash of the vehicle **102**, as further described below. Such data regarding the crash of the vehicle **102** may be provided to and/or used by the insurance provider (e.g., at the call management device(s) **110**), where the insurance provider may provide insurance coverage with respect to the vehicle **102** and an insured party or parties (e.g., a user(s) of the first mobile computing device **116** and/or the second mobile computing device **122**, such as the driver **112** and/or the front passenger **118**), as further described herein. In some embodiments, such data regarding the crash of the vehicle **102** may be stored in the database **108** for retrieval by, for example, the remote computing device(s) **106** when, for example, an insured party calls the insurance provider to initiate a claim associated with the crash, electronically initiates a claim with the insurance provider, etc.

[0029] The call management device(s) **110** may include any suitable device or devices at, for example, a call center (e.g., claim center) of the insurance provider to receive, place, and otherwise process telephone calls, for example. For example, the call management device(s) **110** may include one or more telephones; one or more computing devices communicatively coupled to the telephones and, for example, communicatively coupled to the computer network **104** and/or the remote computing device(s) **106**; etc. As such, an incoming call to the insurance provider (e.g., to initiate a claim associated with a crash of the vehicle **102**) may be received and processed using the call management device(s) **110** in conjunction with, for example, information received at the call management device(s) **110** from the remote computing device(s) **106**, as further described below.

[0030] Still further, as also further described below, the first mobile computing device **116** and/or the second mobile computing device **122**, for example, may be used in generating sensor data (e.g., from one or more sensors included in the first mobile computing device **116** and/or the second mobile computing device **122**, as described above) corresponding to a period of time before the crash of the vehicle **102** and sensor data corresponding to a period of time after the crash of the vehicle **102**. The sensor data corresponding to the periods of time before and after the crash of the vehicle **102** may be collected by a buffer(s) of the first mobile computing device **116** and/or the second mobile computing device **122**, and may then be stored in additional data storage of the first mobile computing device **116** and/or the second mobile computing device **122**.

[0031] As further discussed below, one or more additional mobile computing devices may be present in the vehicle **102** (e.g., in rear seats of the vehicle **102**, as further discussed with respect to, for example, FIG. **5**), and may be used in performing actions such as those described above and discussed in further detail below. Moreover, while mobile computing devices such as the first mobile computing device **116** and the second mobile computing device **122** are shown and described as being associated with (e.g., possessed by a user sitting in) particular seats of the vehicle **102**, the various computing devices described herein may have different associations with seats of the vehicle **102**; may not be associated with any particular seat; one or more seats may not have an associated computing device; etc.

II. Example Computing Device

[0032] FIG. **2** illustrates an example computing device **150** and components thereof. An instance or instances of the computing device **150**, or portions thereof, may be an implementation(s) of, for example, one or more of one or more of the remote computing device(s) **106**, one or more of the call management device(s) **110**, the first mobile computing device **116**, or the second mobile computing device **122**. The computing device **150** may include sensors, such as when the computing device **150** is an implementation of the first mobile computing device **116** or the second mobile computing device **122**. More particularly, the sensors may include, for example, a gyroscope **152**, a pressure sensor **154** (e.g., a barometric pressure sensor), a sound monitoring component **156** (e.g., a microphone), a magnetic sensor **158** (e.g., a magnetometer), and an accelerometer **160**. As with other components shown in the figures and described herein, any suitable number of each of the sensors **152**-**160** may be included in a particular implementation of one of the computing devices described herein, and/or one or more of the sensors **152**-**160** may be omitted in a particular implementation of one of the computing devices described herein.

[0033] The computing device **150** may include a controller **162**. The controller **162** may include a program memory **164**, a microcontroller or a microprocessor **166**, a memory **168**, and an input/output (I/O) circuit **170**, all of which may be interconnected via an address/data bus **172**. The program memory **164** may store computer-executable instructions, which may be executed by the microprocessor **166**. The memory **168** may include one or more forms of volatile and/or non-volatile, fixed and/or removable memory, such as read-only memory (ROM), electronic programmable read-only memory (EPROM), random access memory (RAM), erasable electronic programmable read-only memory (EEPROM), and/or other hard drives, flash memory, MicroSD cards, and/or other suitable form(s) of memory.

[0034] It should be appreciated that although FIG. **2** depicts only one microprocessor **166**, the controller **162** may include multiple microprocessors **166**. Similarly, the program memory **164** of the controller **162** may include additional RAM(s) **174** and multiple program memories **176**A, **176**B and/or **176**C (or any suitable number of multiple program memories) storing one or more corresponding modules, routines, and/or instructions, etc. used in, for example, generating vehicle crash data, according to the particular configuration of the controller **162** and the computing device **150**. Additionally, although FIG. **2** depicts the I/O circuit **170** as a single block, the I/O circuit **170** may include a number of different types of I/O circuits (not depicted). The RAM(s) **174** and the program memory/memories **176**A, **176**B and/or **176**C may be implemented in any known form of non-transitory computer readable storage media, including but not limited to semiconductor memories, magnetically readable memories, and/or optically readable memories. It should also be appreciated that the computing device **150** may include additional, fewer, or alternate components, such as depending on a particular device described herein of which the computing device **150** is an implementation.

III. Example Method for Generating Indication of Whether Vehicle Crash has Occurred

[0035] FIG. **3** is a flow chart of an example method, routine, or process **200** for generating an indication of whether a vehicle crash has occurred, such as a crash of the vehicle **102**. One or more processors, which may be one or more processors of the first mobile computing device **116**, such as

a microprocessor(s) implemented as described above with respect to FIG. **2**, may determine whether base sensor data output by one or more base sensors of a mobile computing device indicates that a condition corresponding to a crash of the vehicle **102** has occurred (block **202**). The mobile computing device may be, for example, the first mobile computing device **116**, and the one or more processors (which may be one or more processors of the first mobile computing device **116**, as noted above) may perform the determination described with respect to block **202** by receiving base sensor data from the base sensor(s) of the first mobile computing device **116** when the first mobile computing device **116** is present within the vehicle **102**. For example, the first mobile computing device **116** may be a smart phone of, or otherwise possessed by or in the control of, the driver **112**. In another embodiment, the one or more processors may be one or more processors of the second mobile computing device **122**, and/or the mobile computing device including the base sensor(s) may be the second mobile computing device **122**.

[0036] The one or more processors may perform the actions described with respect to block **202**, and the actions described with respect to other blocks herein, by executing computer-executable instructions stored in, for example, one or more program memories such as the program memories **176**A, **176**B, and/or **176**C when the computing device **150** is an implementation of a mobile computing device that includes the one or more processors and one or more program memories. The computer-executable instructions executed by the one or more processors to perform actions described herein may constitute, for example, one or more smart phone apps used for crash detection and post-crash actions as further discussed below. Such an app(s) may be provided by the insurance provider and made available to a user (e.g., insured party) for download to the first mobile computing device **116**

[0037] With further reference to the actions described with respect to block **202**, in one embodiment, the one or more base sensors may include the accelerometer **160**, and the base sensor data may be or may include acceleration data output by the accelerometer **160**. The determination of whether the base sensor data output by the one or more base sensors indicates that a condition corresponding to a crash of the vehicle **102** has occurred may be or may include a determination of whether an amount of acceleration indicated by the accelerometer **160** is at least a certain number of "g" s. For example, if the amount of acceleration indicated by the accelerometer **160** is equal to or greater than such a certain number or threshold number of "g" s, such an indication by the accelerometer **160** may be an indication of a condition corresponding to a crash of the vehicle **102**, because the vehicle **102** may be more likely to experience a high magnitude of acceleration (e.g., a sudden stop) in the event of a crash.

[0038] With continued reference to the actions described with respect to block **202**, a suitable sensor or sensors other than or in addition to the accelerometer **160** may be or may be included in the one or more base sensors and may output the base sensor data or a portion(s) thereof. As just one example, the gyroscope **152** may be included in the base sensor(s), and an output from the gyroscope **152** that is equal to or greater than a predetermined number of radians per second may indicate that a condition corresponding to a crash of the vehicle **102** has occurred, for example.

[0039] If it is determined with respect to block **202** that the base sensor data indicates that a condition corresponding to a crash of the vehicle **102** has not occurred, the example method, routine, or process **200** may remain at the determination described with respect to block **202** until it is determined that the base sensor data indicates that a condition corresponding to a crash of the vehicle **102** has occurred.

[0040] If it is determined that the base sensor data indicates that a condition corresponding to a crash of the vehicle **102** has occurred, the one or more processors (e.g., one or more processors of the first mobile computing device **116**, as described above) may cause at least one additional sensor of the mobile computing device (e.g., the first mobile computing device **116**) to begin outputting additional sensor data (block **204**). For example, where the base sensor(s) is the accelerometer **160**, the one or more processors may cause one or more of the gyroscope **152**, the pressure sensor **154**,

the magnetic sensor **156**, or the sound monitoring component **158** to turn on or otherwise activate or begin operation, and thereby begin outputting additional sensor data. In this manner, the accelerometer **160** or other suitable base sensor(s) may advantageously be used to determine whether a condition corresponding to a crash of the vehicle **102** has occurred without having to use all sensors of the mobile computing device (e.g., the first mobile computing device **116**). When such a condition (e.g., which may correspond to particular output(s) of the base sensor(s) as discussed above) has occurred, the additional sensor(s) may be caused to output the additional sensor data in order to increase the accuracy of an indication of whether a crash of the vehicle **102** has occurred, with such an indication being further discussed below.

[0041] For example, the additional sensor(s) may increase the accuracy of an indication of whether a crash has occurred by providing additional data, and/or by providing data where the base sensor(s) may not be able to provide sufficiently accurate outputs. As one example, where the base sensor(s) includes the accelerometer **160**, the accelerometer **160** may in some mobile computing devices, such as the first mobile computing device **116**, be limited in the number of "g"'s that can be detected and outputted by the accelerometer **160**. Accordingly, use of the additional sensor(s) in such an example may improve the accuracy of an indication of whether a crash has occurred. It will be appreciated in light of the teaching and disclosure herein that power consumption by, for example, the first mobile computing device **116** may advantageously be reduced by not operating the additional sensor(s) unless a condition corresponding to a crash has occurred.

[0042] The one or more processors may cause the at least one additional sensor of the first mobile computing device **116** (or other suitable mobile computing device, as discussed herein) to output the additional sensor data for an amount of time (e.g., a predetermined amount of time) after the at least one additional sensor begins outputting the additional sensor data (block **206**). The amount of time may be, for example, a predetermined amount of time that corresponds to an expected duration of a crash of the vehicle **102**. For example, the insurance provider may have determined that a typical vehicle crash has a duration of less than three-tenths of a second, and the app used to perform actions described herein (such an app being discussed above) may thus cause the first mobile computing device **116**, and more particularly the one or more processors thereof, to cause the at least one additional sensor to output the additional sensor data for three-tenths of a second. It will be appreciated any other suitable time may be used as the amount of time during which the at least one additional sensor is caused to output the additional sensor data, and that the app may be configured (e.g., by the insurance provider) accordingly.

[0043] The one or more processors may receive an indication from at least a second mobile computing device (e.g., the second mobile computing device **122** and/or an additional mobile computing device(s) such as one of the additional mobile computing device(s) further discussed with respect to FIG. **5**) of whether the crash of the vehicle **102** has occurred, where the at least the second mobile computing device may be located within the vehicle **102** (block **208**). The indication from the at least the second mobile computing device of whether the crash of the vehicle **102** has occurred may be determined by the at least the second mobile computing device in any suitable manner. In some embodiments, the indication from the at least the second mobile computing device of whether the crash of the vehicle **102** has occurred may be or may include further sensor data from at least one sensor of the at least the second mobile computing device. For example, at least one sensor of the at least the second mobile computing device, such as at least one sensor of one of the types of sensors **152-160** shown and described with respect to FIG. **2**, may output sensor data that may indicate whether a crash of the vehicle **102** has occurred, and this sensor data may be received using the one or more processors of the first mobile computing device **116**.

[0044] The sensor data received from the at least the second mobile computing device using the one or more processors of the first mobile computing device **116** may, for example, be used in conjunction with the base sensor data and the additional sensor data described above to generate an indication of whether the crash of the vehicle **102** has occurred, as further described below. In some

embodiments, the sensor data received from the at least the second mobile computing device may include at least second base sensor data and/or at least second additional sensor data. The at least second base sensor data and/or the at least second additional sensor data may be received, for example, where one or more of the at least the second mobile computing device uses a base sensor(s) to determine whether a condition corresponding to a crash of the vehicle **102** has occurred and uses an additional sensor(s) to output additional sensor data in a manner similar to that described with respect to the first mobile computing device **116**.

[0045] With continued reference to the actions described with respect to block **208**, in another example, one or more processors of the at least the second mobile computing device may perform actions similar to those described above with respect to blocks **202**, **204**, and **206**, and may analyze resulting base sensor data and additional sensor data output by sensors of the at least the second mobile computing device. The one or more processors of the at least the second mobile computing device may thus determine the indication that is received using the one or more processors of the first mobile computing device **116**, as described with respect to block **208**, based on an analysis of such sensor data from the at least the second mobile computing device. In this example, the indication received as described with respect to block **208** may not include all or a portion of such sensor data from the at least the second mobile computing device, but instead may include data resulting from an analysis of such sensor data.

[0046] In a further example, the one or more processors of the at least the second mobile computing device may analyze sensor data from any suitable sensor or sensors, such as the sensors shown and described with respect to FIG. **2**, in order to determine the indication from the at least the second mobile computing device of whether the crash of the vehicle **102** has occurred. In such an example, the at least the second mobile computing device need not use one or more base sensors and need not cause at least one additional sensor to begin outputting additional sensor data in the same manner as described with respect to the first mobile computing device **116**. For example, the one or more processors of the at least the second mobile computing device may cause any suitable sensor or sensors of the at least the second mobile computing device (such as one or more of the types of sensors **152-160**) to operate concurrently and to output sensor data that may be analyzed to determine the indication from the at least the second mobile computing device of whether the crash of the vehicle **102** has occurred.

[0047] The one or more processors may generate an indication of whether the crash of the vehicle **102** has occurred (block **210**). In various embodiments, the one or more processors may generate the indication of whether the crash of the vehicle **102** has occurred based on one or more of the additional sensor data caused to be outputted as described with respect to blocks **204** and **206**; the base sensor data; the indication from the at least the second mobile computing device of whether the crash of the vehicle **102** has occurred; a geographic location(s) of each of the first mobile computing device **116** and/or the at least the second mobile computing device; and/or any other suitable factors. For example, the indication of whether the crash has occurred may be based on factors such as whether the additional sensor data includes an output of the gyroscope **152** that is more than a particular (e.g., predetermined) number of radians per second; whether the additional sensor data includes a change in an output of the pressure sensor **154** that is more than a particular number of millibars; whether the additional sensor data includes a change in an output of the sound monitoring component **156** that is more than a particular number of decibels; whether the additional sensor data includes a change in an output of the magnetic sensor **158** that is more than a particular amount; and/or any other suitable factor(s).

[0048] When the indication of whether the crash of the vehicle **102** has occurred is an indication that the crash of the vehicle **102** has occurred, a notification and/or prompt may be displayed to a user of the first mobile computing device **116** and/or to a user(s) of the at least the second mobile computing device (e.g., a user(s) of the second mobile computing device **122** and/or an additional mobile computing device(s) such as those discussed with respect to FIG. **5**), as further discussed

below. When the indication of whether the crash of the vehicle **102** has occurred is an indication that the crash of the vehicle **102** has not occurred, the one or more processors may cause the app to, for example, adjust the manner of analysis of the base sensor data so as to prevent "false alarms" in which the base sensor data indicates a condition corresponding to a crash when a crash has not actually occurred. For example, the one or more processors may implement a machine learning process and/or other suitable techniques to make such an adjustment(s). Additionally or alternatively, when the indication of whether the crash of the vehicle **102** has occurred is an indication that the crash of the vehicle **102** has not occurred, the one or more processors may cause the app to, for example, adjust the manner of analysis of the base and/or additional sensor data from the base and/or additional sensors of the first mobile computing device **116** in conjunction with sensor data from the at least the second mobile computing device, such as by way of a machine learning process.

[0049] The one or more processors may generate at least one of an indication of a severity of the crash of the vehicle **102**, an indication of a location of the vehicle **102** at a time of the crash of the vehicle, an indication of the time of the crash of the vehicle **102**, an indication of a speed of the vehicle **102** at the time of the crash, or an indication of a Delta-V associated with the crash of the vehicle **102** (block **212**). The indication(s) generated as described with respect to block **212** may be generated based on, for example, the base sensor data output by the at least one base sensor of the first mobile computing device **116** and/or based on, for example, the additional sensor data output by the at least one additional sensor of the first mobile computing device **116**. In some embodiments, the indication(s) generated as described with respect to block **212** may be generated further based on, for example, the aforementioned indication from the at least the second mobile computing device of whether the crash of the vehicle **102** has occurred (which indication may be or include, for example, sensor data or another suitable indication as described above with respect to block **208**).

[0050] The indication of the Delta-V associated with the crash of the vehicle **102** may be an indication of Delta-V as used in vehicle crash analysis, and thus may be an indication of the difference between the velocity of the vehicle **102** before and after the crash of the vehicle **102**. Higher values of Delta-V may, for example, indicate higher vehicle crash severities, higher likelihoods of injuries in vehicle crashes, etc.

[0051] Furthermore, in some embodiments, the actions described with respect to block **212** may also or alternatively include generating one or more other suitable indications, such as, for example, an indication of a number of occupants of the vehicle **102** at the time of the crash. The indication of the number of occupants of the vehicle **102** at the time of the crash may be generated based on, for example, the one or more processors of the first mobile computing device **116** causing the first mobile computing device **116** to operate in a beacon receive mode to receive a signal or signals from an additional mobile computing device(s) that may operate in a beacon transmit mode. The signal(s) received from the additional mobile computing device(s) may include, for example, one or more indication(s) from the additional mobile computing device(s) that a crash of the vehicle **102** has occurred. The additional mobile computing device(s) may transmit BLUETOOTH® signals, for example. The low power of BLUETOOTH® signals may allow an assumption that any BLUETOOTH® signal received by the first mobile computing device **116** from an additional mobile computing device is received from an additional mobile computing device that is located within the vehicle **102**, and thus associated with an occupant of the vehicle **102**. In this manner, the indication of the number of occupants of the vehicle **102** may be determined. It will be appreciated, however, that any suitable type(s) of signal(s) may be transmitted by the additional mobile computing device(s). Additionally, the indication of the number of occupants of the vehicle **102** may be determined in any suitable manner and need not utilize, for example, the beacon transmit and beacon receive mode features described herein.

[0052] Additionally or alternatively, the signal(s) transmitted by the additional mobile computing

device(s) (e.g., BLUETOOTH® signals) may include location information of the additional mobile computing device(s), such as Global Positioning System (GPS) information. For example, the aforementioned app for crash detection, as installed on each of the additional mobile computing device(s), may cause each of the additional mobile computing device(s) to transmit such location information, which location information may be received using the one or more processors of the first mobile computing device **116**. Such location information may be compared, such as using the one or more processors of the first mobile computing device **116**, with location information of the first mobile computing device **116** to determine whether the additional mobile computing device(s) are within the vehicle **102** and associated with additional occupant(s) of the vehicle **102**.

[0053] With continued reference to the actions described with respect to block **212**, and with particular reference to the aforementioned beacon receive and beacon transmit modes, in one embodiment, the aforementioned app for crash detection may be installed on the first mobile computing device **116** and each of the additional mobile computing device(s) (e.g., the second mobile computing device **122** and/or other mobile computing device(s) such as those discussed with respect to FIG. **5**). The app may be configured such that when the one or more processors of the first mobile computing device **116** determine that the base sensor data indicates that a condition corresponding to a crash of the vehicle **102** has occurred, the first mobile computing device **116** is caused to operate in the beacon receive mode. The app for crash detection may also be configured such that when the first mobile computing device **116** is caused to operate in the beacon receive mode, the additional mobile computing device(s) are caused to operate or remain operating in the beacon transmit mode.

[0054] More particularly, in one embodiment, the app may be configured to cause the one or more processors of the first mobile computing device **116** to cause the first mobile computing device **116** to transmit a signal to the additional mobile computing device(s) indicating that the base sensor data of the first mobile computing device **116** indicates that a condition corresponding to a crash has occurred. When the first mobile computing device **116** transmits such a signal to the additional mobile computing device(s), the app may be configured to cause the one or more processors of the first mobile computing device **116** to cause the mobile computing device **116** to begin operating in the beacon receive mode. Additionally, when the first mobile computing device **116** transmits such a signal to the additional mobile computing device(s), the app may be configured such that upon receipt of such a signal by the additional mobile computing device(s), the app as installed on the additional mobile computing device(s) causes the additional mobile computing device(s) to operate in the beacon transmit mode.

[0055] As will be apparent from the above description, and as should be appreciated with respect to all examples presented in this disclosure, various ones of the functions or operations shown in FIG. **3** are optional. Furthermore, the functions or operations shown in FIG. **3** (and each flow chart herein) may be performed in any suitable order, any desired number of times, and/or with any suitable variation to the particular order and/or combination shown so as to achieve a desired result, such as a desired manner of generating an indication of whether a crash of a vehicle (e.g., the vehicle **102**) has occurred.

IV. Example Method for Providing Post-Crash Information after Indication that Vehicle Crash has Occurred

[0056] FIG. **4** is a flow chart of an example method, routine, or process **300** for providing post-crash information after an indication that a vehicle crash has occurred. It will be appreciated from the teaching and disclosure below that various features of the example method, routine, or process **300** may be further features of the example method, routine, or process **200**.

[0057] One or more processors, which may be one or more processors of the first mobile computing device **116**, may determine whether the indication of whether the crash of the vehicle **102** has occurred (e.g., as described with respect to block **210**) is an indication that the crash of the vehicle **102** has occurred (block **302**). If it is determined that the indication of whether the crash of

the vehicle **102** has occurred is an indication that the crash of the vehicle **102** has not occurred, the method **300** may remain at the determination described with respect to block **302** until it is determined that the indication of whether the crash of the vehicle **102** has occurred is an indication that the crash of the vehicle **102** has occurred.

[0058] If it is determined that the indication of whether the crash of the vehicle **102** has occurred is an indication that the crash of the vehicle **102** has occurred, the one or more processors may determine whether the vehicle **102** is stopped (block **304**). For example, the one or more processors may use location information (e.g., GPS information) of the first mobile computing device **116** to determine whether the location of the first mobile computing device **116** is changing, and thus that the vehicle **102** is not stopped, or whether the location of the first mobile computing device **116** is not changing and thus the vehicle **102** is stopped. The one or more processors may perform any suitable additional or alternative actions to determine whether the vehicle **102** is stopped. If it is determined that the vehicle **102** is not stopped, the method **300** may remain at the determination described with respect to block **304** until it is determined that the vehicle **102** is stopped.

[0059] If it is determined that the vehicle **102** is stopped, the one or more processors may cause at least one of a notification of the crash of the vehicle **102** or a prompt associated with the crash of the vehicle **102** to be provided to the user (e.g., insured party such as the driver **112**) of the first mobile computing device **116**, such as via a user interface (e.g., display and/or other suitable user interface component(s)) of the first mobile computing device **116** (block **306**). The notification and/or prompt may indicate that the first mobile computing device **116** has generated an indication that the crash of the vehicle **102** has occurred, and in some embodiments may prompt the user to confirm that the crash of the vehicle **102** has actually occurred or, alternatively, to indicate that the vehicle **102** has not been involved in a crash. For example, the base sensor data and/or the additional sensor data may represent a "false alarm" and thus indicate a crash when a crash has not actually occurred. Such a false alarm may occur if, for example, the first mobile computing device **116** is dropped while within the vehicle **102**, or otherwise experiences a sudden movement and/or change in movement even though the vehicle **102** is not involved in a crash.

[0060] The one or more processors may determine whether the user has confirmed (e.g., via the user interface of the first mobile computing device **116**) that the crash of the vehicle **102** occurred (block **308**). If it is determined that the user has indicated that the crash of the vehicle **102** has not occurred, the method may end (block **310**). If it is determined that the crash of the vehicle **102** has occurred (e.g., that the user has confirmed that the crash of the vehicle **102** has occurred), it may be determined whether the user wishes to send data regarding the crash of the vehicle **102** from the first mobile computing device **116** to the insurance provider (block **312**). For example, the notification and/or prompt provided to the user may include an inquiry as to whether the user wishes to send the data regarding the crash to the insurance provider. The inquiry may be presented, for example, by way of an option on a touch screen display of the first mobile computing device **116**. In one embodiment, the inquiry as to whether the user wishes to send the data regarding the crash to the insurance provider may be presented via the touch screen display after the user selects a previous option presented via the touch screen display to confirm that the crash has occurred, as discussed with respect to block **308**.

[0061] If it is determined with respect to block **312** that the user wishes to send the data regarding the crash to the insurance provider, the one or more processors may send the data regarding the crash of the vehicle **102** to the insurance provider (block **314**). For example, the one or more processors may cause the data regarding the crash of the vehicle **102** to be sent using at least a portion of an I/O circuit, such as the I/O circuit **170**, to the remote computing device(s) **106** via the computer network **104**. As further discussed below, the data regarding the crash of the vehicle **102** that is sent by the first mobile computing device **116** to the insurance provider may be used by the insurance provider to, for example, facilitate the initiation of a claim submission by the insured party without the insured party having to determine and provide such data to the insurance

provider. In some embodiments, the data regarding the crash of the vehicle **102** may be used as discussed herein and the insured party may be asked, electronically or via phone, for example, to confirm aspects of the data regarding the crash of the vehicle **102** (e.g., that a crash occurred, a severity of the crash, a time of day, etc.) as received by the insurance provider. In some embodiments, the data regarding the crash of the vehicle **102** may also or alternatively be used by the insurance provider as part of a general process of determining correspondence between amounts of loss in claims and severity of vehicle crashes. The results of such determinations may be used, for example, by the crash detection app to improve determinations of indications of severity as described herein.

[0062] If it is determined with respect to block **312** that the user does not wish to send the data regarding the crash to the insurance provider, the one or more processors may cause one or more indications of one or more other options for informing the insurance provider of the crash of the vehicle **102** and, for example, initiating a claim with the insurance provider with respect to the crash, to be provided to the user of the first mobile computing device **116** (block **316**). For example, the one or more processors may cause the first mobile computing device **116** to display, or otherwise provide via a user interface, one or more of a contact telephone number for the insurance provider; one or more contact addresses for the insurance provider; a list of information that should be provided to the insurance provider when initiating a claim with the insurance provider with respect to the crash; an option(s) to schedule a time for a claim representative of the insurance provider to contact the user, such as by providing one or more suitable touch screen options; and/or any other suitable information for initiating a claim with the insurance provider.

[0063] With continued reference to the actions performed when it is determined with respect to block **312** that the user wishes to send the data regarding the crash of the vehicle **102** from the first mobile computing device **116** to the insurance provider, as noted above with respect to block **314**, the one or more processors may send such data to the insurance provider. With continued reference to the actions described with respect to block **314**, in one embodiment, such data may be considered claim information and may be stored (e.g., in the database **108**) for use in processing a claim when, for example, the user calls the insurance provider to proceed with claim processing, as further discussed below. In another embodiment, the data regarding the crash of the vehicle **102** may be stored (e.g., in the database **108**) but may not be considered claim information. For example, the user may be asked to decide at a later time, such as when calling the insurance provider as described below, if the user wishes to submit a claim with respect to the crash of the vehicle **102**, and if the user does wish to submit a claim, the stored data regarding the crash may then be considered claim information and may be used in processing the claim.

[0064] The one or more processors may initiate a telephone call from the first mobile computing device **116** to the insurance provider, such as via the computer network to the call management device(s) **110** (block **318**). The initiating of the telephone call may include the one or more processors making available to the insurance provider identifying data associated with the first mobile computing device **116**, where the identifying data associated with the first mobile computing device **116** may correlate the first mobile computing device **116** with the data regarding the crash of the vehicle **102**. For example, the identifying data may be a telephone number of the first mobile computing device **116** where the first mobile computing device **116** is a smart phone, and may thus be made available automatically when the telephone call is initiated from the first mobile computing device **116** to the insurance provider. In another example, the identifying data may be an insurance policy number of the user of the first mobile computing device **116** (e.g., the insured party), and the one or more processors of the first mobile computing device **116** may cause the insurance policy number to be transmitted to the call management device(s) **110**, for example, when the telephone call is initiated. Generally speaking, the identifying data associated with the first mobile computing device **116** may be any suitable data that correlates the first mobile computing device **116** with the data regarding the crash of the vehicle **102**, and allows the

insurance provider to determine that the data regarding the crash of the vehicle **102** corresponds to the first mobile computing device **116**.

[0065] In one embodiment, when the telephone call is initiated, the call management device(s) **110** may perform a lookup of the identifying data made available to the insurance provider by communicating with, for example, one or more of the remote computing device(s) **106**, such as an insurance provider server. For example, when the identifying data made available to the insurance provider is a telephone number of the first mobile computing device **116**, the call management device(s) **110** may query the one or more of the remote computing device(s) **106**, or otherwise communicate with the one or more of the remote computing device(s) **106**, to match the telephone number with data regarding a vehicle crash. In some cases, the data regarding the vehicle crash may have been stored in the database **108**, and the remote computing device(s) **106** may in turn query or otherwise communicate with the database **108** in response to the query or other communication from the call management device(s) **110**. In other examples, the call management device(s) **110** may query or otherwise communicate with the database **108** instead of querying or otherwise communicating with the remote computing device(s) **106**. The call management device(s) **110** may similarly communicate with the remote computing device(s) **106** or the database **108** when the identifying data made available to the insurance provider (e.g., transmitted to the call management device(s) **110**) is data other than a telephone number, such as an insurance policy number as discussed above.

[0066] In any event, with continued reference to the actions described with respect to block **318**, the data regarding a vehicle crash that corresponds to (correlates with) the first mobile computing device **116** (e.g., the data regarding the crash of the vehicle **102**) may be retrieved from one or more of the remote computing device(s) **106** or from the database **108** using the identifying data made available to the insurance provider. If the data regarding the crash of the vehicle **102** is considered claim information, as discussed above, one or more of the call management device(s) **110**, which may be located at a claim processing center of the insurance provider, may use such claim information to populate fields of a claim that may be shown on a computing device display to an employee or contractor of the insurance provider. For example, the fields of the claim may be populated using such claim information when an employee or contractor of the insurance provider answers the telephone call. Such claim information may include, for example, one or more of an indication of a time of the crash of the vehicle **102**, an indication of a location (e.g., using GPS coordinates) of the crash of the vehicle **102**, an indication of a severity of the crash of the vehicle **102**, and/or any other suitable claim information.

[0067] With further reference to the actions described with respect to block **318**, in examples where the data regarding the crash of the vehicle **102** is not considered claim information, as discussed above, the user may need to decide whether to submit a claim with regard to the crash of the vehicle **102** when the telephone call from the first mobile computing device **116** to the insurance provider is initiated. For example, the user may inform an employee or contractor of the insurance provider who answers the telephone call, or may inform an automated service that answers the telephone call, that the user wishes to submit a claim. The data regarding the crash of the vehicle **102** may then, for example, be populated into fields of a claim that may be shown on a computing device, or may otherwise be used to facilitate the claim process.

[0068] In some embodiments, the user (e.g., insured party such as the driver **112**) may be requested to provide additional information to establish or complete a First Notice of Loss (FNOL). As such, the one or more processors may receive and/or provide one or more of a post-crash-detection indication(s) from and/or to the user (e.g., insured party) of the first mobile computing device **116**; a post-crash-detection request(s) from and/or to the user; a post-crash-detection input(s) from the user; or any other suitable information from and/or to the user (block **320**).

[0069] More particularly, in various embodiments, the one or more processors of the first mobile computing device **116** may at least one of receive an indication from the user of the first mobile

computing device **116** of a severity of the crash of the vehicle **102**; receive (e.g., from memory of the first mobile computing device **116**) and provide to the user an indication of at least one of at least one individual or at least one entity for the user to contact regarding the crash of the vehicle (e.g., an emergency contact person, the insurance provider, etc.); receive an indication from the user (e.g., by way of a text message, such as in response to a prompt sent to the first mobile computing device **116** after the user confirms that the crash of the vehicle **102** has occurred) of whether any occupant of the vehicle has been injured in the crash of the vehicle **102**; receive a request from the user for information regarding post-crash guidelines (e.g., suggestions regarding how to communicate with a driver of another vehicle involved in the crash, a reminder to get insurance information of the driver of the other vehicle involved in the crash, etc.) for the user to follow after the crash of the vehicle **102** and/or provide such information regarding post-crash guidelines to the user; receive an input from the user to adjust data regarding the crash of the vehicle **102** that is to be sent to the insurance provider (e.g., default text or other element(s) of an electronic communication to be sent to the insurance provider to provide data regarding the crash, such as the data regarding the crash as described with respect to blocks **312** and **314**); receive a request from the user to view via a user interface of the first mobile computing device **116** one or more images of an insurance card corresponding to the insurance coverage associated with the vehicle **102**; provide such one or more images of the insurance card via the user interface for viewing by the user; receive a request from the user for a tow truck to be deployed to a location of the crash of the vehicle **102**; receive a request from the user for transportation of the user (e.g., as facilitated by the insurance provider) from the location of the crash of the vehicle **102**; receive a request from the user for the insurance provider to arrange use of a rental vehicle for the user; receive an input from the user to initiate an electronic claim process to file a claim associated with the crash of the vehicle **102** with the insurance provider; receive an input from the user to initiate contact via the first mobile computing device **116** (e.g., by way of a telephone call) with an agent of the insurance provider; and/or receive and/or provide any other suitable and/or desired indication(s), request(s), input(s), or other information.

V. Example System for Generating Vehicle Crash Data

[0070] FIG. **5** illustrates the example system **100** for generating vehicle crash data in greater detail. As shown in FIG. **5**, the system **100** may include the vehicle **102**, the computer network **104**, the remote computing device(s) **106**, the database **108**, and the call management device(s) **110**. The vehicle **102** is shown as including the driver seat **114**, the front passenger seat **120**, a left rear passenger seat **402**, and a right rear passenger seat **404**. In the example of FIG. **5**, the first mobile computing device **116** may be associated with (e.g., possessed by) a driver (not shown in FIG. **5**) sitting in the driver seat **114**, and the second mobile computing device **122** may be associated with a passenger (not shown in FIG. **5**) sitting in the front passenger seat **120**. FIG. **5** also illustrates a third mobile computing device **406** and a fourth mobile computing device **408**, which may be a smart watch. The third and fourth mobile computing devices **406** and **408** may be associated with occupants (not shown in FIG. **5**) of the left rear passenger seat **402** and the right rear passenger seat **404**, respectively.

[0071] As further illustrated in FIG. **5**, the first, second, and third mobile computing devices **116**, **122**, and **406** may be communicatively coupled to the computer network **104** so as to communicate with, for example, the remote computing device(s) **106** and the call management device(s) **110** in a similar manner as discussed above with respect to, for example, the first mobile computing device **116**. In one embodiment, the smart watch **408** may not directly communicate with the computer network **104** (e.g., the Internet) but may communicate with the computer network **104** indirectly by being communicatively coupled to another one of the computing devices, such as, for example, the first mobile computing device **116**. With further reference to the discussion above, it will be appreciated that the configuration of computing devices and seats as shown in FIG. **5** is by way of example only. For example, the first, second, third, and fourth mobile computing devices **116**, **122**,

406, and **408** may be in different seats than shown in FIG. **5**; the vehicle **102** may include more or fewer seats; the vehicle **102** may include more or fewer computing devices; and/or any other suitable modifications to the arrangement shown in FIG. **5** may be made.

[0072] FIG. **5** also illustrates communication links from each one of the mobile computing devices **116**, **122**, **406**, and **408** to each other one of the mobile computing devices **116**, **122**, **406**, and **408**. Each such communication link may be any suitable wireless or wired communication link. It will be appreciated that not all of the communication links between the mobile computing devices **116**, **122**, **406**, and **408** shown in FIG. **5** need be present in a particular embodiment. For example, a suitable subset of the communication links shown between the mobile computing devices **116**, **122**, **406**, and **408** shown in FIG. **5** may be present in a particular embodiment. In some embodiments, the communication links between the mobile computing devices **116**, **122**, **406**, and **408** may be or may include BLUETOOTH® communication links used in implementing a wireless ad hoc network in which each of the mobile computing devices **116**, **122**, **406**, and **408** operates in a beacon receive mode or a beacon transmit mode, as discussed above and further discussed below.

[0073] In some embodiments, the remote computing device(s) **106** may include one or more insurance provider servers, as discussed above, and the one or more insurance provider servers may be or may include one or more cloud computing servers with which the mobile computing devices **116**, **122**, **406**, and **408** may communicate via the computer network **104**.

VI. Example Methods for Generating Vehicle Crash Data

[0074] FIG. **6** is a flow chart of an example method, routine, or process **500** for generating vehicle crash data, such as data regarding a crash of the vehicle **102**. One or more processors may determine whether the first mobile computing device **116** within the vehicle **102** has detected that a crash of the vehicle **102** has occurred (block **502**). In some embodiments, the one or more processors may be or may include one or more processors of the first mobile computing device **116**. The determination of whether the first mobile computing device **116** has detected that a crash of the vehicle **102** has occurred may be made, for example, in the manner described above with respect to, for example, FIG. **3**. In some embodiments, the one or more processors may also or alternatively be or include one or more processors of one or more of the remote computing device(s) **106**. In such embodiments, the determination of whether the first mobile computing device **116** has detected that a crash of the vehicle **102** has occurred may include receiving, using the one or more processors of the one or more of the remote computing device(s) **106**, an indication from the first mobile computing device **116** of whether the crash of the vehicle **102** has occurred. Such an indication may be determined, for example, in the manner described above with respect to FIG. **3**.

[0075] If it is determined with respect to block **502** that the first mobile computing device **116** has not detected that a crash of the vehicle **102** has occurred, the one or more processors may determine whether at least a second mobile computing device (e.g., the second mobile computing device **122** and/or the third mobile computing device **406**) within the vehicle **102** has detected that a crash of the vehicle **102** has occurred (block **504**). For example, one or more processors of the first mobile computing device **116** may determine whether the first mobile computing device **116** has received an indication from the at least the second mobile computing device (e.g., one or more of the mobile computing devices **122** or **406**) that the crash of the vehicle **102** has occurred. Such an indication may be determined by the at least the second mobile computing device in the manner described above with respect to FIG. **3**, for example. In some embodiments, the one or more processors may also or alternatively be or include one or more processors of one or more of the remote computing device(s) **106**, as discussed with respect to block **502**. In such embodiments, the determination of whether the at least the second mobile computing device has detected that a crash of the vehicle **102** has occurred may include receiving, using the one or more processors of the one or more of the remote computing device(s) **106**, an indication from the at least the second mobile computing device of whether the crash of the vehicle **102** has occurred. As discussed above, such an indication

may be determined, for example, in the manner described with respect to FIG. **3**.

[0076] If it is determined with respect to block **504** that the at least the second mobile computing device has not detected that a crash of the vehicle **102** has occurred, the method **500** may return to the determination as described with respect to the block **502**, and thus the method **500** may not proceed past the determinations described with respect to blocks **502** and **504** until it is determined that at least one of the first or the at least the second mobile computing devices has detected that a crash has occurred. Conversely, if it is determined with respect to either block **502** or block **504** that the first mobile computing device **116** (block **502**) or the at least the second mobile computing device (block **504**) has detected that a crash of the vehicle **102** has occurred, the one or more processors may receive sensor data output by at least one sensor (block **506**). More particularly, with continued reference to the actions described with respect to block **506**, the at least one sensor may be at least one sensor of at least one of the first mobile computing device **116** or the at least the second mobile computing device. The sensor data output by the at least one sensor of the at least one of the first mobile computing device **116** or the at least the second mobile computing device may be associated with the detected crash of the vehicle **102** (e.g., by being sensor data output at a time that matches a time of the detected crash of the vehicle **102**).

[0077] The one or more processors may receive further sensor data output by at least one sensor of a further mobile computing device (e.g., the fourth mobile computing device **408**, which as noted above may be a smart watch, for example) (block **508**). The at least one further sensor may include at least one sensor of the types of sensors **152-160** discussed with respect to the computing device **150**, for example. The further mobile computing device may be communicatively coupled to the first mobile computing device **116** (e.g., by way of the fourth mobile computing device **408** being communicatively coupled, such as via BLUETOOTH® communication, to the first mobile computing device **116**), and the further sensor data may be associated with the detected crash of the vehicle **102** (e.g., by being sensor data output at a time that matches a time of the detected crash of the vehicle **102**). In some embodiments, the further sensor data may be used in generating vehicle crash data as described below. As discussed above with reference to the actions described with respect to blocks **502** and **504**, the one or more processors may be or may include one or more processors of, for example, the first mobile computing device **116** and/or one or more of the remote computing device(s) **106**, and the further sensor data may be received accordingly. For example, in an embodiment where the one or more processors include one or more processors of one or more of the remote computing device(s) **106** (such as one or more processors of a cloud computing device of the insurance provider), and where the further mobile computing device is communicatively coupled to the first mobile computing device **116**, the one or more processors may receive the further sensor data from the first mobile computing device **116**.

[0078] The one or more processors (which, again, may be or may include one or more processors of, for example, the first mobile computing device **116** and/or one or more of the remote computing device(s) **106**) may generate the vehicle crash data (block **510**). More particularly, with continued reference to the actions described with respect to block **510**, the one or more processors may generate the vehicle crash data based on the sensor data associated with the detected crash of the vehicle **102** as output by the at least one sensor of the at least one of the first mobile computing device **116** or the at least the second mobile computing device. For example, by analyzing such sensor data, the one or more processors may generate the vehicle crash data so that the vehicle crash data includes at least one of an initial confirmation that the crash of the vehicle **102** has occurred, an indication of a severity of the crash of the vehicle **102**, an indication of a number of occupants of the vehicle **102** at a time of the crash, or an indication that the crash of the vehicle **102** has not occurred.

[0079] With continued reference to the actions described with respect to block **510**, in one embodiment, the first mobile computing device **116** or one or more of the at least the second mobile computing device may have detected that the crash of the vehicle **102** has occurred, and

sensor data received from another mobile computing device(s) of the first and/or second mobile computing device(s) as described with respect to block **508** may provide a confirmation that the crash has occurred or, conversely, may provide an indication that the crash has not actually occurred. In one embodiment, where any of the first mobile computing device **116** or the at least the second mobile computing device detects that the crash of the vehicle **102** has occurred, as described with respect to blocks **502** and **504**, a subsequent indication that the crash has not actually occurred as described with respect to block **510** may be used by the mobile computing device(s) that detected the crash in, for example, a machine learning process as described above. Such use in a machine learning process, for example, may improve the accuracy of crash detection, severity classification, etc. by the mobile computing device(s) that detected the crash.

[0080] With further reference to the actions described with respect to block **510**, in some embodiments, the one or more processors may additionally or alternatively generate the vehicle crash data based on, for each one of the first mobile computing device **116** and/or the at least the second mobile computing device, at least one of (i) a respective geographic location of the mobile computing device (e.g., as determined by a GPS unit of the mobile computing device), or (ii) a respective indication of a time (e.g., as determined by the mobile computing device) that at least a portion of the sensor data output by the at least one sensor of the at least one of the first mobile computing device **116** or the at least the second mobile computing device was output by at least one sensor of the respective mobile computing device. In this manner, the vehicle crash data may be generated based on collating sensor data from different ones of the mobile computing devices based on indicated geographic locations and/or times at which the sensor data of the different mobile computing devices was output.

[0081] Among other advantages, generation of the vehicle crash data in this manner may be more likely to accurately account for differences in sensor outputs among the mobile computing devices (e.g., the mobile computing devices **116**, **122**, and **406**) based on a subset of the mobile computing devices being relatively farther apart from one another as compared to another subset of the mobile computing devices. Additionally or alternatively, among other advantages, if, for example, one of the mobile computing devices **116**, **122**, or **406** outputs sensor data at an indicated time that is different from indicated times at which the others of the mobile computing devices **116**, **122**, or **406** output sensor data, the sensor data output by the one of the mobile computing devices may be treated with relatively lower importance or weight in the analysis of the sensor data and generation of the vehicle crash data.

[0082] More generally, use of sensor data from multiple mobile computing devices as described herein may improve the accuracy of the vehicle crash data even without use of indicated geographic locations and/or times at which the sensor data of different ones of the multiple mobile computing devices was output. For example, a mobile computing device, such as a smart phone, may experience significant movement unrelated to any vehicle crash, such as if the mobile computing device is dropped, moved suddenly by a user from one hand to another, picked up or put down by the user, re-oriented by the user, etc. By using sensor data from multiple mobile computing devices in the vehicle **102**, sensor data that may correspond to sensor data present when a crash occurs but that does not actually reflect a crash may have less influence on the generated vehicle crash data, because sensor data from another mobile computing device(s) in the vehicle **102** is relatively unlikely to correspond to sensor data present when a crash occurs unless a crash has actually occurred. Additionally, the use of multiple mobile computing devices as described herein may improve aspects of the vehicle crash data such as the indicated severity, indicated number of occupants, etc. by providing more sensor data upon which to base such indications. Still further, the use of multiple mobile computing devices as described herein may improve accuracy of the vehicle crash data by providing sensor data from one or more mobile computing devices that may have more sensitive sensors (e.g., the first mobile computing device **116**) to augment sensor data from one or more mobile computing devices that may, for example, be less expensive and/or incorporate

older technology and thus have less sensitive sensors, for example (e.g., the second mobile computing device **122**).

[0083] With still further reference to the actions described with respect to block **510**, in some embodiments, the one or more processors may additionally or alternatively generate the vehicle crash data based on the further sensor data. As such, sensor data from, for example, the fourth mobile computing device **408** (e.g., a smart watch) may also be utilized in generating the vehicle crash data, even in examples such as that shown in FIG. **5** where the further (e.g., fourth) mobile computing device communicates with the computer network **104** indirectly through one of the first, second, or third mobile computing devices **116**, **122**, or **406**.

[0084] FIG. **7** is a flow chart of another example method, routine, or process **600** for generating vehicle crash data, such as data regarding a crash of the vehicle **102**. It will be appreciated from the teaching and disclosure herein that actions described with respect to the example method, routine, or process **600** of FIG. **7** may constitute particular implementations of actions described with respect to the example method, routine, or process **500** of FIG. **6**.

[0085] One or more processors may determine whether the first mobile computing device **116** within the vehicle **102** has detected that a crash of the vehicle **102** has occurred based on at least a portion of the sensor data output by the at least one sensor of the at least one of the first mobile computing device **116** or the at least the second mobile computing device, where the at least the portion of such sensor data includes sensor data output by at least one sensor of the first mobile computing device **116** (block **602**). It will be appreciated that the actions described with respect to block **602** may correspond to a more particular implementation of the actions described with respect to block **502** of FIG. **6**. Additionally, in various embodiments, the one or more processors may be or may include one or more processors of the first mobile computing device **116** and/or one or more processors of one or more of the remote computing device(s) **106**, for example.

[0086] The one or more processors may cause the first mobile computing device **116** to operate in a beacon receive mode to receive a signal indicating that the crash of the vehicle **102** has occurred (block **604**). With reference to the discussion above, in some embodiments, the first mobile computing device **116** may be caused to operate in the beacon receive mode after it is determined that the first mobile computing device **116** has detected that the crash of the vehicle **102** has occurred. For example, with reference to the discussion of FIG. **3** above, the first mobile computing device **116** may in some embodiments transmit a signal indicating that base sensor data received by one or more processors of the first mobile computing device **116** indicates that a condition corresponding to a crash has occurred, and the signal may be received by, for example, the second, third, and fourth mobile computing devices **122**, **406**, and **408**. In other embodiments, the first mobile computing device **116** may transmit such a signal when the first mobile computing device **116** has detected a crash of the vehicle **102** (e.g., when the one or more processors generate an indication that the crash has occurred based on, for example, additional sensor data associated with the first mobile computing device **116** as described above). In such embodiments, the signal may be received by, for example, the second, third, and fourth mobile computing devices **122**, **406**, and **408**. In some embodiments, when the first mobile computing device **116** transmits such a signal, the one or more processors may cause the first mobile computing device **116** to begin operating in the beacon receive mode, as further discussed above with respect to FIG. **3**. With further reference to the discussion of FIG. **3**, upon receipt of such a signal, the second, third, and fourth mobile computing devices **122**, **406**, and **408** may be caused to operate in a beacon transmit mode.

[0087] With continued reference to the actions described with respect to block **604**, the mobile computing devices **116**, **122**, **406**, and **408** may thus form a wireless ad hoc network using, for example, BLUETOOTH® communication with the first mobile computing device **116** operating in a beacon receive mode after detecting a crash or a crash condition, and with the remaining mobile computing devices operating in a beacon transmit mode. It will be appreciated, however, that any suitable ad hoc network may be formed, which may or may not utilize BLUETOOTH®

communication, and/or which may or may not include the mobile computing devices **116**, **122**, **406**, and **408** operating in beacon receive and beacon transmit modes such as described above. It will further be appreciated that while the first mobile computing device **116** is at times described herein as detecting the crash of the vehicle **102** or the crash condition, in various embodiments, each of the mobile computing devices **116**, **122**, **406**, and **408** may detect the crash of the vehicle **102** at any time. In such embodiments, for example, the one of the mobile computing devices **116**, **122**, **406**, or **408** that detects the crash of the vehicle **102** first may perform the actions described herein as being performed by the first mobile computing device **116** (e.g., operating in a beacon receive mode or otherwise "listening for" or receiving one or more signals from the other mobile computing devices indicative of detection of the crash of the vehicle **102**).

[0088] The one or more processors may determine whether the first mobile computing device **116** operating in the beacon receive mode has received the signal indicating that the crash of the vehicle **102** has occurred from at least one of the at least the second mobile computing device (e.g., at least one of the second mobile computing device **122** or the third mobile computing device **406**) (block **606**). In this manner, the mobile computing device (e.g., the first mobile computing device **116**) that first detects that the crash of the vehicle **102** has occurred may determine whether other nearby devices have also detected that the crash of the vehicle **102** has occurred. As described with respect to block **604**, in other embodiments, the first mobile computing device **116** may communicate with the mobile computing devices **122**, **406**, and/or **408**, for example, in any suitable wireless ad hoc network, which need not utilize beacon transmit and beacon receive modes and/or which need not utilize BLUETOOTH® communication.

[0089] With continued reference to the actions described with respect to block **606**, and as discussed above with respect to FIG. **6**, the combination of data from multiple mobile computing devices regarding whether the crash of the vehicle **102** has been detected may improve the accuracy of the vehicle crash data generated by, for example, the first mobile computing device **116**. Thus, for example, the first mobile computing device **116** may detect a crash, but no other mobile computing device may detect a crash, and the vehicle crash data generated by the first mobile computing device **116** may indicate that no crash actually occurred (with such vehicle crash data depending, for example, upon factors such as geographic location and/or times of sensor outputs). In this example, the first mobile computing device **116** may be caused (e.g., by the aforementioned app executed by the one or more processors) to change, for example, the manner in which the first mobile computing device **116** analyzes sensor data to detect whether the crash of the vehicle **102** has occurred, and thus may provide more accurate detection data for use in ultimately generating the vehicle crash data as described herein. With reference to the discussion of FIG. **6**, such changing of the manner in which the first mobile computing device **116** analyzes, for example, sensor data may result from, for example, a machine learning process implemented using the first mobile computing device **116**.

[0090] With further reference to the actions described with respect to block **606**, it will also be appreciated that grouping or collating of data from mobile computing devices based on geographic location and/or times of sensor outputs, such as in the manner discussed above with respect to FIG. **6**, may accurately account for differences in sensor outputs among the mobile computing devices. Furthermore, when two mobile computing devices have an existing relationship other than a wireless ad hoc network, such as the fourth mobile computing device **408** (e.g., a smart watch) being communicatively coupled to the first mobile computing device **116**, sensor data output by each of such two mobile computing devices (e.g., the fourth mobile computing device **408** and the first mobile computing device **116**) may be compared. In this manner, for example, the accuracy of generating the vehicle crash data may be further increased by assessing related sensor data from multiple perspectives.

[0091] It will be appreciated in light of the teaching and disclosure herein that actions described with respect to blocks **604** and **606** may correspond to implementations of the actions described

with respect to block **504**.

[0092] The one or more processors may also send the sensor data output by the at least one sensor of the at least the first mobile computing device **116** or the at least the second mobile computing device to one or more of the remote computing device(s) **106** (block **608**). For example, one or more processors of the first mobile computing device **116** may send such sensor data to a cloud computing device (e.g., cloud computing server) of the insurance provider, which cloud computing device may be one of the remote computing device(s) **106**. As noted above, the one or more processors may include one or more processors of one or more of the remote computing device(s) **106**, and as such may include one or more processors of such a cloud computing device. Consequently, in some embodiments, the aforementioned sensor data may be analyzed by one or more processors of such a cloud computing device, and the one or more processors of such a cloud computing device may perform the generation of the vehicle crash data as described with respect to, for example, block **510** of FIG. **6**.

VII. Example Computing Device for Generating Data Regarding a Vehicle Crash

[0093] FIG. **8** illustrates an implementation of the example computing device **150** and components thereof that may be used in generating data regarding a vehicle crash, such as a crash of the vehicle **102** as described herein. As described with respect to FIG. **2**, an instance or instances of the computing device **150**, or portions thereof, may be an implementation(s) of any suitable computing device such as, for example, one or more of the first, second, third, or fourth mobile computing devices **116**, **122**, **406**, or **408**. As shown in FIG. **8**, the computing device **150** may include one or more sensors **702**, which may be or may include, for example, any suitable one or more of the sensors **152**-**160** described above with respect to FIG. **2**. The remaining description of the computing device **150** with respect to FIG. **8** will include description of components not also shown in FIG. **2**, it being understood that the components shown in FIG. **8** and also shown in FIG. **2** may be configured and/or may operate in the manner described with respect to FIG. **2**.

[0094] As shown in FIG. **8**, the computing device **150** may include a buffer **704**, where the buffer may be a suitable portion of the memory **168** that includes, for example, data **706**-**716**. In one embodiment, before a crash of the vehicle **102** is detected, the data **706**-**716** may include, for example, initial sensor data output by at least one sensor of a mobile computing device (e.g., the first mobile computing device **116**) of which the computing device **150** is an implementation. In particular, first data **706** may be a first received element of the initial sensor data output by the sensor(s) of the first mobile computing device **116** and, as shown in FIG. **8**, is designated "DATA0." Second data **708** may be a second received element of the initial sensor data output by the sensor(s) and may be designated "DATA1." Third data **710** may be a third received element of the initial sensor data output by the sensor(s) and may be designated "DATA2." Fourth data **712** may be a fourth received element of the initial sensor data output by the sensor(s) and may be designated "DATA3." Fifth data **714** may be a fifth received element of the initial sensor data output by the sensor(s) and may be designated "DATA4." Sixth data **716** may be a sixth received element of the initial sensor data output by the sensor(s) and may be designated "DATA5."

[0095] In some embodiments, the buffer **704** may be a first-in first-out (FIFO) buffer. Additionally or alternatively, in some embodiments, the buffer **704** may be implemented as a circular buffer. As such, if a next (e.g., seventh) element of initial sensor data (e.g., sensor data output by the sensor(s) of the first mobile computing device **116** that includes the buffer **704**) is received at the buffer **704**, such a seventh element of initial sensor data, which may be designated "DATA6" may be written into the buffer **704** as the first data **706**, and may overwrite the first received element of the initial sensor data designated as "DATA0." That is, the first received element "DATA0," which in this example is the oldest (e.g., earliest received) element of data, may be removed from the buffer **704** to make room for the seventh received element "DATA6." Similarly, if an eighth element of initial sensor data, which may be designated "DATA7," is received at the buffer **704**, the eighth element may be written into the buffer **704** as the second data **708**, and may overwrite the second received

element "DATA1," which would at the time of receipt of the eighth element be the oldest element of data remaining in the buffer **704**.

[0096] It will be appreciated in light of the teaching and disclosure herein that the buffer **704** may be of any suitable size (e.g., may include storage space for any suitable number of data elements, such as more than or less than six elements). As further described below with respect to FIG. **9**, the contents of the buffer **704** may be stored in additional data storage **718** (e.g., as first sensor data **720** within the additional data storage **718**) within the memory **168** when a crash of the vehicle **102** is detected, and the buffer **704** may then receive post-crash sensor data. The post-crash sensor data, as further described below, may also be stored in the additional data storage **718** (e.g., as second sensor data **722** within the additional data storage **718**) to generate, for example, a file containing sensor data from both before and after the detected crash of the vehicle **102**.

VIII. Example Method for Generating Data Regarding a Vehicle Crash

[0097] FIG. **9** is a flow chart of an example method, routine, or process **800** for generating data regarding a vehicle crash, such as a crash of the vehicle **102** as described herein. One or more processors, which may be one or more processors of the first mobile computing device **116**, such as a microprocessor(s) implemented as shown and described with respect to FIGS. **2** and **8**, may receive initial sensor data output by at least one sensor of a mobile computing device (e.g., the first mobile computing device **116**), such as initial sensor data output by at least one sensor of the types of sensors **152-160** (block **802**).

[0098] The one or more processors may store the initial sensor data in the buffer **704**, where as discussed above, the buffer **704** may be included in the first mobile computing device **116** (block **804**). In one embodiment, the buffer **704** may include storage capacity for a first amount of sensor data (e.g., six elements of sensor data as shown in the example of FIG. **8**). In another embodiment, the buffer **704** may include storage capacity for the lower of a second amount of sensor data (which may be any suitable amount of sensor data, and may be the same as or different from the first amount of sensor data) or an amount of sensor data that corresponds to a particular amount of time (e.g., a predetermined amount of time of collection of sensor output(s)).

[0099] In any event, the initial sensor data stored in the buffer **704** as described with respect to block **804** may in some embodiments be regarded as including first and second portions. The one or more processors may remove a portion of the initial sensor data (e.g., the second portion) from the buffer **704** when an amount of the initial sensor data exceeds a storage capacity of the buffer **704** (e.g., exceeds six elements of sensor data) (block **806**). Thus, the second portion of the initial sensor data may be the oldest initial sensor data in the buffer **704**, which may be removed from the buffer **704** (e.g., discarded, overwritten, etc.) when newer initial sensor data is stored in the buffer **704** and the buffer **704** no longer has storage capacity for the oldest initial sensor data. Correspondingly, the first portion of the initial sensor data may be regarded as the newest initial sensor data (e.g., that portion of the initial sensor data that is not the oldest initial sensor data that is removed from the buffer **704** as described above).

[0100] The one or more processors may determine whether the initial sensor data output by the at least one sensor of the mobile computing device (e.g., the first mobile computing device **116**) and stored in the buffer **704** includes sensor data indicating that a crash of the vehicle **102** has occurred (block **808**). In some embodiments, each element of sensor data stored in the buffer **704** may include data from multiple sensors of the first mobile computing device **116**, such as each of the sensors **152-160** when each of the sensors **152-160** is outputting sensor data (as discussed with respect to, for example, FIGS. **1** and **3**). The determination of whether the initial sensor data output by the at least one sensor of the mobile computing devices indicates that a crash of the vehicle **102** has occurred may be made in any suitable manner, such as by any suitable analysis of the initial sensor data in the buffer **704**, which may include real-time analysis of the initial sensor data as the initial sensor data is received at and stored in the buffer **704**. For example, the determination of whether the initial sensor data indicates that a crash of the vehicle **102** has occurred may be made

in a similar manner as discussed above with respect to, for example, FIG. **3**.

[0101] If it is determined with respect to block **808** that the initial sensor data does not indicate that a crash of the vehicle **102** has occurred, the method **800** may return to the actions described with respect to block **802** to continue receiving initial sensor data and performing the actions described with respect to blocks **804**, **806**, and/or **808** until it is determined that the initial sensor data indicates that a crash of the vehicle **102** has occurred. When it is determined with respect to block **808** that the initial sensor data indicates that a crash of the vehicle **102** has occurred, the one or more processors may receive an "index identifier" ("index ID") indicating a particular sensor that provided a sensor output(s) leading to the determination described with respect to block **808** that the initial sensor data indicates that a crash has occurred (block **810**). In another embodiment, multiple "index IDs" indicating multiple sensors may be received when multiple sensors of, for example, the first mobile computing device **116** provided sensor outputs leading to the determination described with respect to block **808** that the initial sensor data indicates that a crash has occurred.

[0102] The one or more processors may cause at least a portion of the initial sensor data stored in the buffer **704** to be stored in the additional data storage **718** of the first mobile computing device **116** (block **812**). For example, the at least the portion of the initial sensor data may be the first portion of the initial sensor data described above, and thus may be the newest initial sensor data, with the oldest initial sensor data (e.g., the second portion of the initial sensor data) having not indicated that a crash has occurred and having been removed/discarded from the buffer **704** as described above. More particularly as to the actions described with respect to block **812**, the one or more processors may cause the at least the portion of the initial sensor data stored in the buffer **704** to be removed from the buffer **704** and stored as the first sensor data **720** within the additional data storage **718**, where the first sensor data **720** thus is or includes sensor data corresponding to a period of time before the crash of the vehicle **102**.

[0103] The one or more processors may receive additional sensor data output by the at least one sensor of the mobile computing device (e.g., the first mobile computing device **116**) for an amount of time after it is determined that the initial sensor data output by the at least one sensor of the mobile computing device includes sensor data indicating that the crash of the vehicle **102** has occurred (block **814**). The amount of time may be a predetermined amount of time corresponding to an expected duration of the crash of the vehicle **102**, in some examples. For example, an expected duration of a vehicle crash in general may be three-tenths of a second, and thus the amount of time during which the additional sensor data is received may be, in various embodiments, three-tenths of a second, a suitable amount of time longer than three-tenths of a second to provide a margin of error, etc. In one embodiment, the additional sensor data may be received for the amount of time by the one or more processors computing or otherwise determining an end time at which the one or more processors may stop receiving the additional sensor data, where the end time may be based on a current time plus the amount of time during which the additional sensor data is to be received. The one or more processors may then receive the additional sensor data until the computed or otherwise determined end time.

[0104] The one or more processors may store the additional sensor data output by the at least one sensor of the first mobile computing device **116** in the buffer **704** (block **816**). In view of the discussion above of the at least the portion of the initial sensor data (e.g., the first portion of the initial sensor data) being removed from the buffer **704** and stored as the first sensor data **720** within the additional data storage **718**, the buffer **704** may be empty at the time the additional sensor data begins to be stored in the buffer **704**. As also noted above, the buffer **704** may have one of several possible example storage capacities to store the additional sensor data.

[0105] The one or more processors may generate combined sensor data based on the initial sensor data stored as the first sensor data **720** and based on the additional sensor data (block **818**). Generating the combined sensor data may include causing, such as at the aforementioned end time,

the additional sensor data to be stored in the additional data storage **718** as the second sensor data **722**, where the second sensor data **722** may thus correspond to a period of time after the crash of the vehicle **102**. As such, in some embodiments, the combined sensor data may include the first sensor data **720** and the second sensor data **722**.

[0106] The one or more processors may correlate the combined sensor data with identifying information associated with the mobile computing device (e.g., a telephone number of the first mobile computing device **116**, an insurance policy number of a user (e.g., insured party) of the first mobile computing device **116**, or any suitable identifying information) (block **820**). The one or more processors may also make available the correlated combined sensor data and identifying data associated with the mobile computing device to the insurance provider (block **822**). For example, such data may be sent to the insurance provider (e.g., to one or more of the remote computing device(s) **106**) in the same or a similar manner as described above with respect to sending data regarding the detected crash to the insurance provider (e.g., as described with respect to FIG. **4**). Thus, as also described above, information may be populated into a claim or otherwise be more readily accessible to the insurance provider if the user of the first mobile computing device **116**, for example, initiates a claim regarding the crash electronically, by a telephone call to the insurance provider, etc.

[0107] It will be appreciated in light of the teaching and disclosure herein that the combined sensor data may have other suitable uses as well. As just one example, the second sensor data **722** may be compared with the first sensor data **720** and information such as differences between the first and second sensor data **720** and **722** (and if desired, one or more sensor-specific differences) may be used in a machine learning process such as that described above, may be used to improve severity classification and thus to improve indications of severity that are determined as described herein, and/or may be used in any other suitable manner.

IX. Additional Considerations

[0108] The following additional considerations apply to the foregoing discussion. Throughout this specification, plural instances may implement functions, components, operations, or structures described as a single instance. As noted above, although individual functions and instructions of one or more methods are illustrated and described as separate operations, one or more of the individual operations may be performed concurrently, and nothing requires that the operations be performed in the order illustrated. Structures and functionality presented as separate components in example configurations may be implemented as a combined structure or component. Similarly, structures and functionality presented as a single component may be implemented as separate components. These and other variations, modifications, additions, and improvements fall within the scope of the subject matter herein.

[0109] The methods described in this application may include one or more functions or routines in the form of non-transitory computer-executable instructions that are stored in a tangible computer-readable storage medium and executed using a processor of a computing device (e.g., the first mobile computing device **116**, one or more of the remote computing device(s) **106**, and/or any other computing devices within the example system **100** in any suitable combination). The routines may be included as part of any of the modules described in relation to FIG. **1** or as part of a module that is external to the system illustrated by FIG. **1**. For example, the methods or portions thereof may be part of a browser application(s) or an application(s) running on any of the devices in the example system **100** as a plug-in or other module of the browser application. Further, the methods may be employed as "software-as-a-service" to provide, for example, the first mobile computing device **116**, one or more of the remote computing device(s) **106**, and/or any other computing devices with access to the example system **100**.

[0110] Additionally, certain aspects are described herein as including logic or a number of functions, components, modules, blocks, or mechanisms. Functions may constitute either software modules (e.g., non-transitory code stored on a tangible machine-readable storage medium) or

hardware modules. A hardware module is a tangible unit capable of performing certain operations and may be configured or arranged in a certain manner. In example embodiments, one or more computer systems (e.g., a standalone, client or server computer system) or one or more hardware modules of a computer system (e.g., a processor or a group of processors) may be configured by software (e.g., an application or application portion) as a hardware module that operates to perform certain operations as described herein.

[0111] In various embodiments, a hardware module may be implemented mechanically or electronically. For example, a hardware module may comprise dedicated circuitry or logic that is permanently configured (e.g., as a special-purpose processor, such as a field programmable gate array (FPGA) or an application-specific integrated circuit (ASIC) to perform certain functions). A hardware module may also comprise programmable logic or circuitry (e.g., as encompassed within a general-purpose processor or other programmable processor) that is temporarily configured by software to perform certain operations. It will be appreciated that the decision to implement a hardware module mechanically, in dedicated and permanently configured circuitry, or in temporarily configured circuitry (e.g., configured by software) may be driven by cost and time considerations.

[0112] Accordingly, the term hardware should be understood to encompass a tangible entity, be that an entity that is physically constructed, permanently configured (e.g., hardwired), or temporarily configured (e.g., programmed) to operate in a certain manner or to perform certain operations described herein. Considering embodiments in which hardware modules are temporarily configured (e.g., programmed), each of the hardware modules need not be configured or instantiated at any one instance in time. For example, where the hardware modules comprise a general-purpose processor configured using software, the general-purpose processor may be configured as respective different hardware modules at different times. Software may accordingly configure a processor, for example, to constitute a particular hardware module at one instance of time and to constitute a different hardware module at a different instance of time.

[0113] Hardware and software modules may provide information to, and receive information from, other hardware and/or software modules. Accordingly, the described hardware modules may be regarded as being communicatively coupled. Where multiple of such hardware or software modules exist contemporaneously, communications may be achieved through signal transmission (e.g., over appropriate circuits and buses) that connect the hardware or software modules. In embodiments in which multiple hardware modules or software are configured or instantiated at different times, communications between such hardware or software modules may be achieved, for example, through the storage and retrieval of information in memory structures to which the multiple hardware or software modules have access. For example, one hardware or software module may perform an operation and store the output of that operation in a memory device to which it is communicatively coupled. A further hardware or software module may then, at a later time, access the memory device to retrieve and process the stored output. Hardware and software modules may also initiate communications with input or output devices, and may operate on a resource (e.g., a collection of information).

[0114] The various operations of example functions and methods described herein may be performed, at least partially, by one or more processors that are temporarily configured (e.g., by software) or permanently configured to perform the relevant operations. Whether temporarily or permanently configured, such processors may constitute processor-implemented modules that operate to perform one or more operations or functions. The modules referred to herein may, in some example embodiments, comprise processor-implemented modules.

[0115] Similarly, the methods or functions described herein may be at least partially processor-implemented. For example, at least some of the functions of a method may be performed by one or processors or processor-implemented hardware modules. The performance of certain of the functions may be distributed among the one or more processors, not only residing within a single

machine, but deployed across a number of machines. In some example embodiments, the processor or processors may be located in a single location (e.g., within a home environment, an office environment or as a server farm), while in other embodiments the processors may be distributed across a number of locations.

[0116] The one or more processors may also operate to support performance of the relevant operations in a "cloud computing" environment or as a "software as a service" (SaaS). For example, at least some of the functions may be performed by a group of computers (as examples of machines including processors), these operations being accessible via a network (e.g., the Internet) and via one or more appropriate interfaces (e.g., application program interfaces (APIs)).

[0117] The performance of certain of the operations may be distributed among the one or more processors, not only residing within a single machine, but deployed across a number of machines. In some example embodiments, the one or more processors or processor-implemented modules may be located in a single geographic location (e.g., within a home environment, an office environment, or a server farm). In other example embodiments, the one or more processors or processor-implemented modules may be distributed across a number of geographic locations.

[0118] Still further, the figures depict preferred embodiments of an example system **100** and methods for purposes of illustration only. One of ordinary skill in the art will readily recognize from the following discussion that alternative embodiments of the structures and methods illustrated herein may be employed without departing from the principles described herein.

[0119] Upon reading this disclosure, those of skill in the art will appreciate still additional alternative structural and functional designs for a system and method for generating data regarding a vehicle crash. Thus, while particular embodiments and applications have been illustrated and described, it is to be understood that the disclosed embodiments are not limited to the precise construction and components disclosed herein. Various modifications, changes and variations, which will be apparent to those skilled in the art, may be made in the arrangement, operation and details of the method and apparatus disclosed herein without departing from the spirit and scope defined in the appended claims.

[0120] To the extent that any meaning or definition of a term in this document conflicts with any meaning or definition of the same term in a document incorporated by reference, the meaning or definition assigned to that term in this document shall govern. Although the text sets forth a detailed description of numerous different embodiments, it should be understood that the legal scope of the description is defined by the words of the claims set forth at the end of this patent. The detailed description is to be construed as exemplary only and does not describe every possible embodiment since describing every possible embodiment would be impractical, if not impossible. Numerous alternative embodiments could be implemented, using either current technology or technology developed after the filing date of this patent, which would still fall within the scope of the claims. While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

Claims

1. A computer-implemented method for generating data regarding a vehicle crash of a vehicle, the method comprising: receiving, using one or more processors of a mobile computing device within the vehicle, initial sensor data; determining, using the one or more processors, that the initial sensor data includes sensor data indicating that the vehicle crash has occurred; in response to the determining, receiving additional sensor data for a first amount of time; and generating, using the one or more processors, combined sensor data that (i) is based on the initial sensor data and the

additional sensor data and (ii) includes first sensor data corresponding to a first period of time before the vehicle crash of the vehicle and second sensor data corresponding to a second period of time after the vehicle crash of the vehicle.

2. The computer-implemented method of claim 1, further comprising: storing, using the one or more processors, the initial sensor data in a buffer of the mobile computing device; and causing, using the one or more processors, at least a portion of the initial sensor data stored in the buffer to be stored in additional data storage of the mobile computing device when it is determined that the initial sensor data includes sensor data indicating that the vehicle crash has occurred.

3. The computer-implemented method of claim 2, wherein the buffer includes storage capacity for one of (a) a first amount of sensor data or (b) a lower of a second amount of sensor data or an amount of sensor data that corresponds to a second amount of time.

4. The computer-implemented method of claim 2, wherein the at least the portion of the initial sensor data stored in the buffer includes a first portion of the initial sensor data stored in the buffer, the buffer is a first-in first-out (FIFO) buffer, and the method further comprises removing, using the one or more processors, a second portion of the initial sensor data stored in the buffer from the buffer when an amount of the initial sensor data exceeds a storage capacity of the buffer.

5. The computer-implemented method of claim 2, the method further comprising storing, using the one or more processors, the additional sensor data in the buffer, wherein generating the combined sensor data includes causing, using the one or more processors, the additional sensor data stored in the buffer to be stored in the additional data storage of the mobile computing device after the first amount of time to generate the combined sensor data including the first sensor data corresponding to the first period of time before the vehicle crash of the vehicle and the second sensor data corresponding to the second period of time after the vehicle crash of the vehicle.

6. The computer-implemented method of claim 1, wherein the first amount of time is a predetermined amount of time corresponding to an expected duration of the vehicle crash of the vehicle.

7. The computer-implemented method of claim 1, further comprising: correlating, using the one or more processors, the combined sensor data with identifying data associated with the mobile computing device; and making available, using the one or more processors, the combined sensor data, as correlated, and the identifying data associated with the mobile computing device, to an insurance provider, the insurance provider providing insurance coverage associated with the vehicle to a user of the mobile computing device.

8. A computing device for generating data regarding a vehicle crash of a vehicle, the computing device comprising: one or more processors; and one or more memories coupled to the one or more processors, wherein the one or more memories include non-transitory computer executable instructions stored therein that, when executed by the one or more processors, cause the one or more processors to: receive initial sensor data via the one or more processors; determine, using the one or more processors, that the initial sensor data includes sensor data indicating that the vehicle crash of the vehicle has occurred; in response to the determining, receive additional sensor data for a first amount of time; and generate, using the one or more processors, combined sensor data that (i) is based on the initial sensor data and the additional sensor data and (ii) includes first sensor data corresponding to a first period of time before the vehicle crash of the vehicle and second sensor data corresponding to a second period of time after the vehicle crash of the vehicle.

9. The computing device of claim 8, wherein the one or more memories further include non-transitory computer executable instructions that when executed cause the one or more processors to: store the initial sensor data in a buffer of the computing device; and cause at least a portion of the initial sensor data stored in the buffer to be stored in additional data storage of the computing device when it is determined that the initial sensor data includes sensor data indicating that the vehicle crash of the vehicle has occurred.

10. The computing device of claim 9, wherein the buffer includes storage capacity for one of (a) a

first amount of sensor data or (b) a lower of a second amount of sensor data or an amount of sensor data that corresponds to a second amount of time.

11. The computing device of claim 9, wherein the at least the portion of the initial sensor data stored in the buffer includes a first portion of the initial sensor data stored in the buffer, the buffer is a first-in first-out (FIFO) buffer, and the one or more memories further include non-transitory computer executable instructions that when executed cause the one or more processors to remove a second portion of the initial sensor data stored in the buffer from the buffer when an amount of the initial sensor data exceeds a storage capacity of the buffer.

12. The computing device of claim 9, wherein the one or more memories further include non-transitory computer executable instructions that when executed cause the one or more processors to: store the additional sensor data in the buffer; and cause the additional sensor data stored in the buffer to be stored in the additional data storage of the computing device after the first amount of time to generate the combined sensor data.

13. The computing device of claim 8, wherein the first amount of time is a predetermined amount of time corresponding to an expected duration of the vehicle crash of the vehicle.

14. The computing device of claim 8, wherein the one or more memories further includes non-transitory computer executable instructions that when executed cause the one or more processors to: correlate the combined sensor data with identifying data associated with the computing device; and make available the combined sensor data, as correlated, and the identifying data associated with the computing device, to an insurance provider, the insurance provider providing insurance coverage associated with the vehicle to a user of the computing device.

15. A computer readable storage medium comprising non-transitory computer readable instructions stored thereon for generating data regarding a vehicle crash of a vehicle, wherein the non-transitory computer readable instructions, when executed on one or more processors, cause the one or more processors to: receive initial sensor data via the one or more processors; determine, using the one or more processors, that the initial sensor data includes sensor data indicating that the vehicle crash has occurred; in response to the determining, receive additional sensor data for a first amount of time; and generate, using the one or more processors, combined sensor data that (i) is based on the initial sensor data and the additional sensor data and (ii) includes first sensor data corresponding to a first period of time before the vehicle crash of the vehicle and second sensor data corresponding to a second period of time after the vehicle crash of the vehicle.

16. The computer readable storage medium of claim 15, further comprising non-transitory computer readable instructions stored thereon that, when executed on the one or more processors, cause the one or more processors to: store the initial sensor data in a buffer of a computing device comprising the one or more processors; and cause at least a portion of the initial sensor data stored in the buffer to be stored in additional data storage of the computing device when it is determined that the initial sensor data includes sensor data indicating that the vehicle crash of the vehicle has occurred.

17. The computer readable storage medium of claim 16, wherein the at least the portion of the initial sensor data stored in the buffer includes a first portion of the initial sensor data stored in the buffer, the buffer is a first-in first-out (FIFO) buffer, and the computer readable storage medium further comprises non-transitory computer readable instructions stored thereon that, when executed on the one or more processors, cause the one or more processors to remove a second portion of the initial sensor data stored in the buffer from the buffer when an amount of the initial sensor data exceeds a storage capacity of the buffer.

18. The computer readable storage medium of claim 16, further comprising non-transitory computer readable instructions stored thereon that, when executed on the one or more processors, cause the one or more processors to: store the additional sensor data in the buffer; and cause the additional sensor data stored in the buffer to be stored in the additional data storage of the computing device after the first amount of time to generate the combined sensor data.

19. The computer readable storage medium of claim 15, wherein the first amount of time being a predetermined amount of time corresponding to an expected duration of the vehicle crash of the vehicle.

20. The computer readable storage medium of claim 15, further comprising non-transitory computer readable instructions stored thereon that, when executed on the one or more processors, cause the one or more processors to: correlate the combined sensor data with identifying data associated with a computing device comprising the one or more processors; and make available the combined sensor data, as correlated, and the identifying data associated with the computing device, to an insurance provider, the insurance provider providing insurance coverage associated with the vehicle to a user of the computing device.