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Thomas et al.

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(54) **SYSTEMS AND METHODS FOR CONTINUOUSLY MONITORING ITEMS**

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G06Q 40/08 (2012.01)
G08B 13/24 (2006.01)

(52) **U.S. Cl.**
CPC ***G06Q 40/08*** (2013.01); ***G08B 13/2448*** (2013.01)

(58) **Field of Classification Search**
CPC G06Q 40/08
See application file for complete search history.

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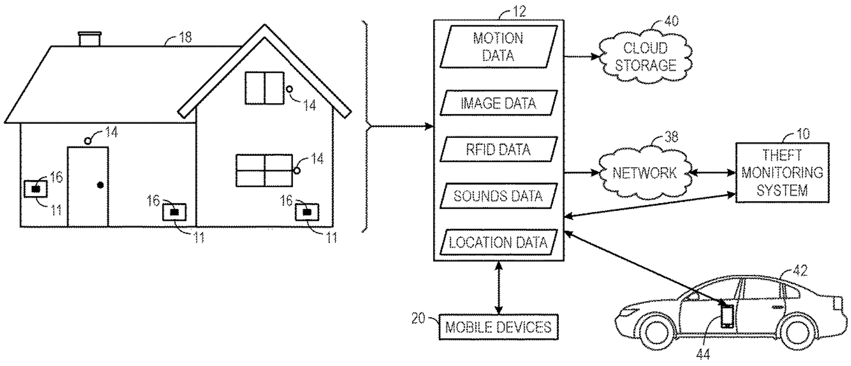
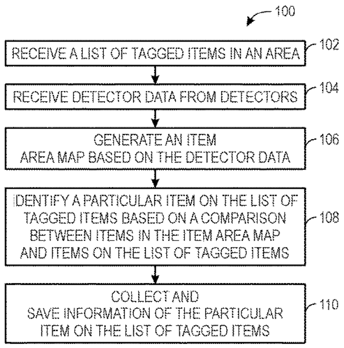
(57) **ABSTRACT**

A system may include one or more detectors configured to generate detector data based on signals received from one or more tags integrated in or disposed on one or more items. The system may include a processor configured to: receive the detector data; determine a first set of identification information corresponding to a first item of the one or more items based on the detector data; receive a list of tagged items for a first location, and the list of tagged items comprises a second set of identification information corresponding to the one or more items; identify a theft incident for the first item based on a comparison of the first and second sets of identification information; automatically send a notification relating to the theft incident to one or more devices; and determine one or more insurance policy decisions for the first item based on the theft incident.

15 Claims, 3 Drawing Sheets




100
RECEIVE A LIST OF TAGGED ITEMS IN AN AREA
102
RECEIVE DETECTOR DATA FROM DETECTORS
104
GENERATE AN ITEM AREA MAP BASED ON THE DETECTOR DATA
106
IDENTIFY A PARTICULAR ITEM ON THE LIST OF TAGGED ITEMS BASED ON A COMPARISON BETWEEN ITEMS IN THE ITEM AREA MAP AND ITEMS ON THE LIST OF TAGGED ITEMS
108
COLLECT AND SAVE INFORMATION OF THE PARTICULAR ITEM ON THE LIST OF TAGGED ITEMS
110

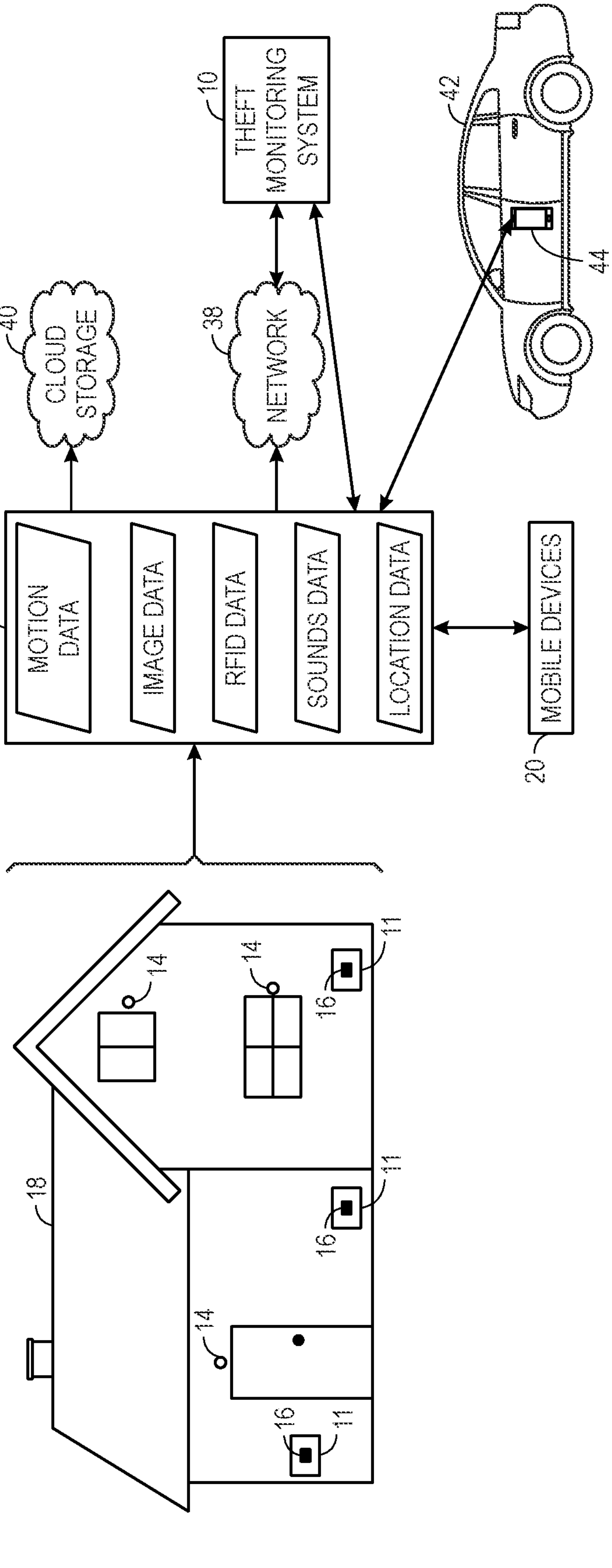

10
THEFT MONITORING SYSTEM
40
CLOUD STORAGE
38
NETWORK
42
44
12
MOTION DATA
IMAGE DATA
RFID DATA
SOUNDS DATA
LOCATION DATA
20
MOBILE DEVICES
18
14
14
14
16
11
16
11
16
11

FIG. 1

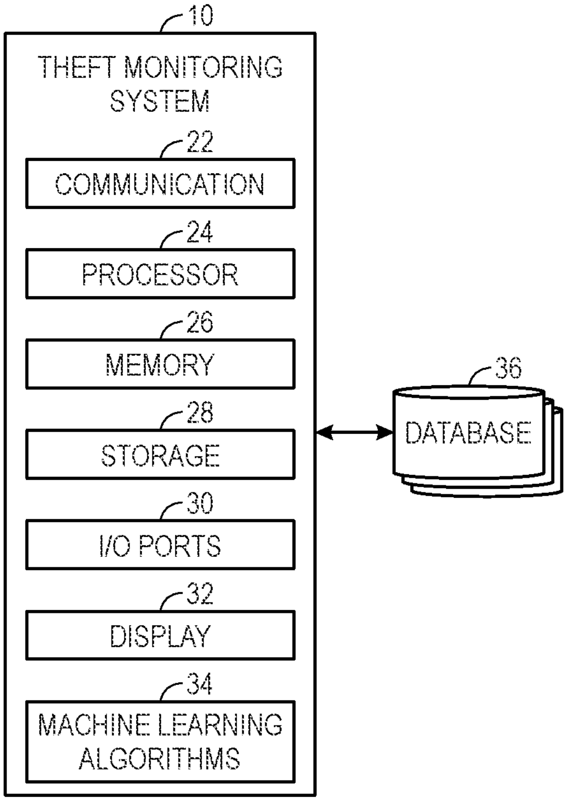
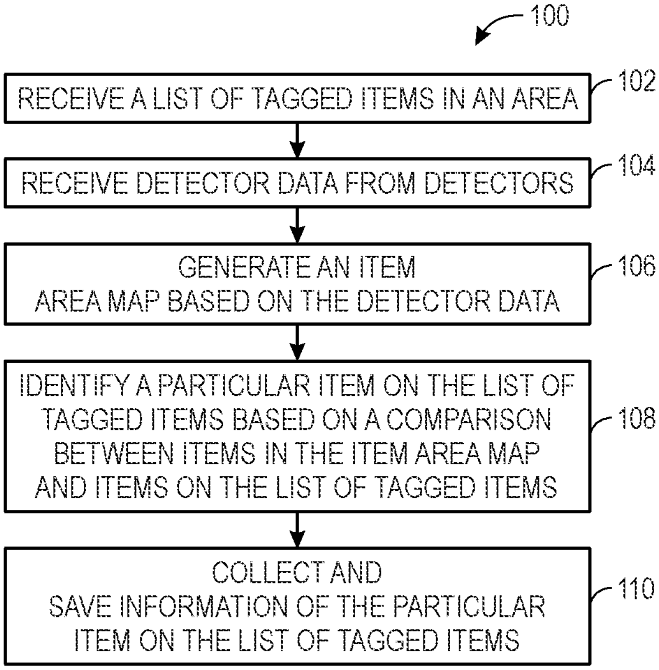

10
THEFT MONITORING SYSTEM
22
COMMUNICATION
24
PROCESSOR
26
MEMORY
28
STORAGE
30
I/O PORTS
32
DISPLAY
34
MACHINE LEARNING ALGORITHMS
36
DATABASE

FIG. 2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108
COLLECT AND SAVE INFORMATION OF THE PARTICULAR ITEM ON THE LIST OF TAGGED ITEMS
110

FIG. 3

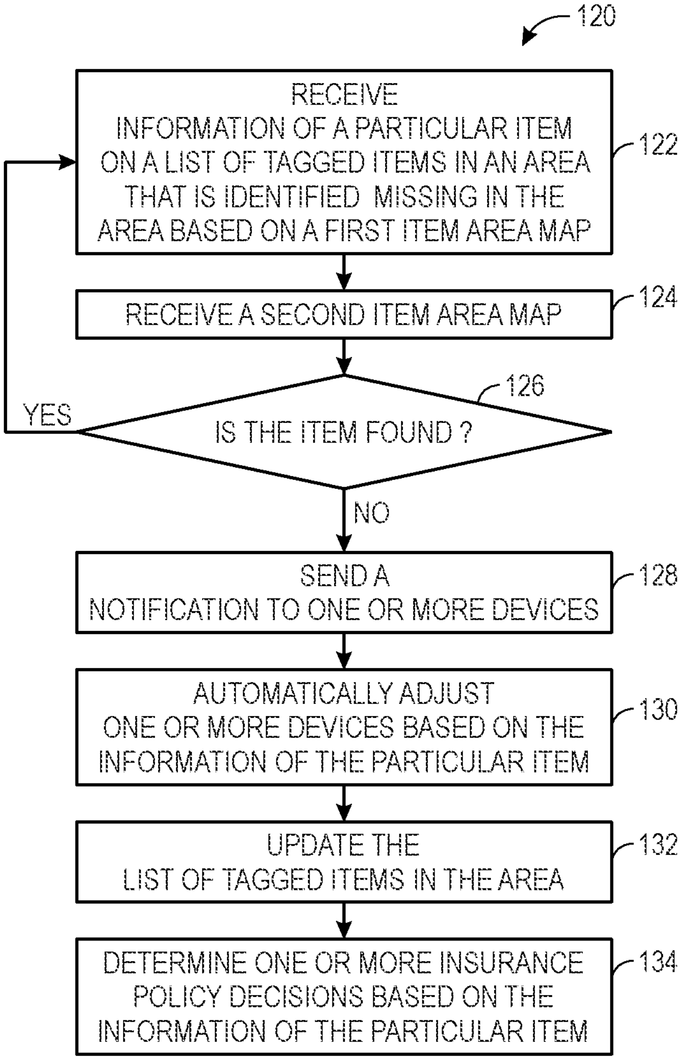
120
RECEIVE INFORMATION OF A PARTICULAR ITEM ON A LIST OF TAGGED ITEMS IN AN AREA THAT IS IDENTIFIED MISSING IN THE AREA BASED ON A FIRST ITEM AREA MAP
122
RECEIVE A SECOND ITEM AREA MAP
124
IS THE ITEM FOUND ?
126
YES
NO
SEND A NOTIFICATION TO ONE OR MORE DEVICES
128
AUTOMATICALLY ADJUST ONE OR MORE DEVICES BASED ON THE INFORMATION OF THE PARTICULAR ITEM
130
UPDATE THE LIST OF TAGGED ITEMS IN THE AREA
132
DETERMINE ONE OR MORE INSURANCE POLICY DECISIONS BASED ON THE INFORMATION OF THE PARTICULAR ITEM
134

FIG. 4

SYSTEMS AND METHODS FOR CONTINUOUSLY MONITORING ITEMS

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to and the benefit of U.S. Provisional Patent Application No. 63/314,739, filed Feb. 28, 2022, entitled "SYSTEMS AND METHODS FOR CONTINUOUSLY MONITORING ITEMS," the disclosure of which is incorporated by reference in its entirety for all purposes.

BACKGROUND

The present disclosure relates generally to systems and methods for continuously monitoring and identifying items. More specifically, the present disclosure generally relates to detecting and monitoring items to identify theft incidents.

Theft incidents oftentimes result in unexpected expenses to insurance companies and their members. Moreover, in many cases, insurance companies may have difficulty to confirm whether a particular item is stolen (e.g., the item may instead be left in a forgotten place). As such, the inability to track items may lead to unnecessary insurance-related costs.

This section is intended to introduce the reader to various aspects of art that may be related to various aspects of the present techniques, which are described and/or claimed below. This discussion is believed to be helpful in providing the reader with background information to facilitate a better understanding of the various aspects of the present disclosure. Accordingly, it should be understood that these statements are to be read in this light, and not as admissions of prior art.

BRIEF DESCRIPTION

A summary of certain embodiments disclosed herein is set forth below. It should be understood that these aspects are presented merely to provide the reader with a brief summary of these certain embodiments and that these aspects are not intended to limit the scope of this disclosure. Indeed, this disclosure may encompass a variety of aspects that may not be set forth below.

In certain embodiments, a system may include one or more detectors configured to generate detector data based on signals received from one or more tags integrated in or disposed on one or more items. The system may also include a theft monitoring system comprising a processor configured to: receive the detector data from the one or more detectors; determine a first set of identification information corresponding to a first item of the one or more items based at least in part on the detector data; receive a list of tagged items for a first location, wherein the list of tagged items comprises a second set of identification information corresponding to the one or more items; identify a theft incident for the first item on the list of tagged items based on a comparison of the first set of identification information and the second set of identification information; automatically send a notification relating to the theft incident to one or more devices; and determine one or more insurance policy decisions for the first item based on the theft incident.

In addition, in certain embodiments, a method may include receiving detector data from one or more detectors configured to receive signals from one or more tags integrated in or disposed on one or more items. The method may

also include determining a first set of identification information corresponding to a first item of the one or more items based at least in part on the detector data. The method may further include receiving a list of tagged items for a first location. The list of tagged items includes a second set of identification information corresponding to the one or more items. In addition, the method may include identifying a theft incident for the first item on the list of tagged items based on a comparison of the first set of identification information and the second set of identification information. The method may also include automatically sending notification relating to the theft incident to one or more devices. The method may further include determining one or more insurance policy decisions for the first item based on the theft incident.

In addition, in certain embodiments, a method may include receiving motion data of an item from a motion sensor. The method may also include determining a recommendation of an operating parameter for a tag associated with the item based on the motion data. The method may further include sending an instruction to cause the tag to send a detection signal using the operating parameter.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects, and advantages of the present invention will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

FIG. **1** illustrates a block diagram of a system communicatively coupled to a number of data sources, in accordance with embodiments described herein;

FIG. **2** illustrates a block diagram of a theft monitoring system, in accordance with embodiments described herein;

FIG. **3** illustrates a flow chart of a method for detecting a particular item based on data acquired from the data sources of FIG. **1**, in accordance with embodiments described herein; and

FIG. **4** illustrates a flow chart of a method for confirming a particular item is stolen based on data acquired from the data sources of FIG. **1**, in accordance with embodiments described herein.

DETAILED DESCRIPTION

One or more specific embodiments will be described below. In an effort to provide a concise description of these embodiments, not all features of an actual implementation are described in the specification. It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation-specific decisions must be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which may vary from one implementation to another. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure.

When introducing elements of various embodiments of the present disclosure, the articles "a," "an," and "the" are intended to mean that there are one or more of the elements. The terms "comprising," "including," and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements. Additionally, it should be understood that references to “one embodiment” or “an embodiment” of the present disclosure are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features.

As used herein, the terms “connect,” “connection,” “connected,” “in connection with,” and “connecting” are used to mean “in direct connection with” or “in connection with via one or more elements”; and the term “set” is used to mean “one element” or “more than one element.” Further, the terms “couple,” “coupling,” “coupled,” “coupled together,” and “coupled with” are used to mean “directly coupled together” or “coupled together via one or more elements.”

In addition, as used herein, the terms “real time”, “real-time”, or “substantially real time” may be used interchangeably and are intended to describe operations (e.g., computing operations) that are performed without any human-perceivable interruption between operations. For example, as used herein, data relating to the systems described herein may be collected, transmitted, and/or used in control computations in “substantially real time” such that data readings, data transfers, and/or data processing steps occur once every second, once every 0.1 second, once every 0.01 second, or even more frequent, during operations of the systems (e.g., while the systems are operating). In addition, as used herein, the terms “continuous”, “continuously”, or “continually” are intended to describe operations that are performed without any significant interruption. For example, as used herein, control commands may be transmitted to certain equipment every five minutes, every minute, every 30 seconds, every 15 seconds, every 10 seconds, every 5 seconds, or even more often, such that operating parameters of the equipment may be adjusted without any significant interruption to the closed-loop control of the equipment. In addition, as used herein, the terms “automatic”, “automated”, “autonomous”, and so forth, are intended to describe operations that are performed are caused to be performed, for example, by a computing system (i.e., solely by the computing system, without human intervention). Indeed, although certain operations described herein may not be explicitly described as being performed continuously and/or automatically in substantially real time during operation of the computing system and/or equipment controlled by the computing system, it will be appreciated that these operations may, in fact, be performed continuously and/or automatically in substantially real time during operation of the computing system and/or equipment controlled by the computing system to improve the functionality of the computing system (e.g., by not requiring human intervention, thereby facilitating faster operational decision-making, as well as improving the accuracy of the operational decision-making by, for example, eliminating the potential for human error), as described in greater detail herein.

Systems and methods described herein enable theft incidents to be detected and notifications of the theft incidents to be automatically sent to certain devices. In addition, in certain embodiments, protective actions may be activated in response to sending and/or receiving the notifications. In addition, in certain embodiments, an insurance company may determine a policy decision (e.g., claim coverage) based on the notifications.

In certain embodiments, theft incidents may be detected by monitoring tags integrated in or disposed on a tangible item. Each tag may be integrated in or disposed on a particular item inside an area (e.g., a household, an office, a storage place, a laboratory, and so forth). In certain embodiments, the items may be furniture (e.g., bed, desk, sofa, and so forth), appliances (e.g., kitchen refrigerators, kitchen ovens, washing machines, dryers, and so forth), devices (e.g., televisions (TVs), computers, Internet routers, safes, and so forth), equipment (e.g., lab equipment, tools, and so forth), instruments (e.g., artistic instruments, scientific instruments, and so forth), entertainment media (e.g., books, CDs, DVDs, and so forth), clothes, accessories (e.g., jewelry), and other tangible items (e.g., a piece of paper, a portion of ceiling, and so forth). Each tag may include one or more sensors (e.g., motion sensors, RFID sensors, location sensors, sound sensors, image sensors, temperature sensors, intelligent electronic devices, beacons, and so forth). In certain embodiments, the tags may be powered by a battery (e.g., rechargeable battery either standing alone or connected to a power system, button cells, and so forth) or by a power supply (e.g., power system, solar panel power system, and so forth), or any combination thereof (e.g., converting to other power supply methods when there is an outage of one power supply). In other embodiments, the tags may not be powered (e.g., may include passive signal receivers). As described in greater detail herein, it may be determined whether a particular tagged item has been moved out of an area by monitoring the tag on the particular tagged item using detectors.

In certain embodiments, detectors (e.g., motion detectors, RFID readers, location detectors, sound detectors, image detectors, intelligent electronic devices, and so forth) may be installed or disposed in an area and powered by a power system or by a battery. In addition, in certain embodiments, detectors may be installed in or disposed on mobile devices (e.g. smart phones, computers, tablets, wearable devices, and so forth). In addition, in certain embodiments, detectors may be installed or disposed in vehicles. In addition, in certain embodiments, detectors may be installed or disposed in an area standing alone, or on items inside the area. In addition, in certain embodiments, detectors may detect an item by detecting and identifying a tag associated with the item, and automatically generate and send detector data to a theft monitoring system.

In certain embodiments, a theft monitoring system may receive a list of tagged items in an area from databases or other data resources. In addition, in certain embodiments, the theft monitoring system may receive detector data from detectors. In certain embodiments, the theft monitoring system may generate an item area map indicating items and their locations in the area based on data received from detectors and/or data received from other sources. In certain embodiments, the theft monitoring system may receive GPS (global positioning system) data or location data from other location tracking devices, and generate an item area map indicating items and their corresponding locations in the area. In certain embodiments, the theft monitoring system may use network traffic data received from network devices (e.g., routers) to generate an item area map (i.e., item network identification associated with virtual network address) for items using the network connections in the area. For example, in certain embodiments, network traffic data packets received by the theft monitoring system may include a MAC address, such that a first portion of the MAC address may indicate that a particular vendor (e.g., manufacturer) is associated with the device and a second portion of the MAC address may indicate that the device corresponds to a particular type of device (e.g., tablet). As such, the MAC address may indicate to the theft monitoring system the particular device being detected. In certain embodiments, the theft monitoring system may compare the list of tagged items in the area with the item area map for the area to determine whether a theft incident has occurred. For example, if the items on the item area map deviate from the items on the list, a theft incident may have occurred.

In certain embodiments, the theft monitoring system may use network data received from network service providers such as internet service providers (e.g., Xfinity, AT&T, and so forth), streaming service providers (e.g., Netflix, Hulu, and so forth), or streaming device manufacturers (e.g., smart devices manufacturers), to monitor an item in the network. For instance, a cable company may identify a particular cable modem online in the network, or a streaming service provider may identify a particular smart TV associated with an account in the network. In addition, a streaming device manufacturer may also identify a particular product in the network. For instance, when a stolen smart TV is activated and connected to the Internet, the TV manufacturer may identify it by recognizing its serial number.

In certain embodiments, the theft monitoring system may use detector data received from detectors outside of an area, such as detectors in other areas (e.g., another room, another building, and so forth), detectors in mobile devices outside of the area (e.g., a smart phone or smart watch travelling with the user), detectors in vehicles outside of the area to confirm whether an item missing in that area is stolen, and so forth. In certain embodiments, the theft monitoring system may compare the information of the missing item in the area with detector data received from the detectors outside of the area to determine whether the missing item is stolen. For example, if detector data received from a mobile device travelling with a user indicates a missing item within the user's house, a theft incident may not have occurred (i.e., the user may have simply taken the item outside the user's house). In addition, in certain embodiments, the theft monitoring system may confirm the missing item by using item area maps generated using data from other sources (e.g., network devices, network service providers, GPS, and so forth).

In certain embodiments, the theft monitoring system may be coupled to another existing monitoring system of the property, or may be stand alone. In addition, in certain embodiments, the theft monitoring system may be installed on a mobile device. In addition, in certain embodiments, the detectors may be portable such that they may be relocatable with respect to the areas that are being monitored. In certain embodiments, the theft monitoring system may be used to monitor the property for a particular period of time. As such, the theft monitoring system may help both an insurance company and the user, may work on-demand, may be easily coupled to other existing systems, may be relatively portable, and so forth.

In certain embodiments, the theft monitoring system may record a theft incident with its time of occurrence and identification and location information of missing items. In addition, in certain embodiments, an insurance company may determine insurance policy coverage based on the record of the theft incident. In certain embodiments, the theft monitoring system may automatically send a notification of the theft incident to certain devices and/or activate protective actions.

By way of introduction, FIG. **1** is a block diagram of a system that includes a number of data sources that may be employed by the embodiments described herein. For example, the system may include a theft monitoring system **10** communicatively coupled to a variety of data sources that may assist the theft monitoring system **10** to monitor theft incidents occurring for an area. Data from the variety of data sources may include insurance data (e.g., existing insurance coverage and premiums) for a user, a list of tagged items **11** in the area that is determined at the initial setup of tags for the area (or updated later), and detector data **12**. The tagged items **11** may be any tangible items **11** (e.g., a portion of wall with painting, a piece of paper of a will, and so forth) in the area as described in greater detail herein. Detector data **12** may be gathered from a variety of detectors **14** (e.g., motion detectors, RFID readers, location detectors, sound detectors, image detectors, intelligent electronic devices, and so forth) monitoring one or more tags **16**, which in certain embodiments may be removably attached to particular tagged items **11**. Each tag **16** may include one or more sensors (e.g., motion sensors, RFID sensors, location sensors, sound sensors, image sensors, temperature sensors, intelligent electronic devices, beacons, and so forth). In certain embodiments, the tags **16** may be integrated in or disposed on particular items **11** located within a property **18**. In certain embodiments, the tags **16** may be powered by a battery (e.g., rechargeable battery either standing alone or connected to a power system, button cells, and so forth) or by a power supply (e.g., power system, solar panel power system, and so forth) that is integrated into the tag **16**, or any combination thereof (e.g., converting to other power supply methods when there is an outage on one power supply). In other embodiments, the tags **16** may not be powered (e.g. passive signal receivers).

In certain embodiments, the tagged items **11** may be furniture (e.g., bed, desk, sofa, and so forth), appliances (e.g., kitchen refrigerators, kitchen ovens, washing machines, dryers, and so forth), devices (e.g., televisions (TVs), computers, Internet routers, safes, and so forth), equipment (e.g., lab equipment, tools, and so forth), instruments (e.g., artistic instruments, scientific instruments, and so forth), entertainment media (e.g., books, CDs, DVDs, and so forth), clothes, accessories (e.g., jewelry), and other tangible tagged items **11** (e.g., a piece of paper, a portion of ceiling, and so forth). Each tag may include one or more sensors (e.g., motion sensors, RFID sensors, location sensors, sound sensors, image sensors, temperature sensors, intelligent electronic devices, beacons, and so forth).

In certain embodiments, the tags **16** may receive/transmit signals from/to the detectors **14**. In certain embodiments, the tags **16** may emit signals comprising identification information of associated tagged items **11** in a predetermined repetition rate (e.g., every 1 hour, every 30 minutes, every 15 minutes, every 5 minutes, and so forth), and the detectors **14** may detect the signals and identify the location of the tags **16**. In other embodiments, the detectors **14** may automatically send out a detecting signal and scan the area to detect reflected or scattered detecting signals from the tags **16** (e.g., RADAR, LIDAR, RFID reader, IR depth camera, and so forth). By way of example, a beacon detector located near an exit of the property **18** (e.g., door or window), battery powered or charged by a power system, may detect a signal transmitted from a beacon attached on a tagged item **11** passing through the exit. Upon detecting the signal from the beacon, the beacon detector may automatically send detector data comprising information of the associated tagged item **11**, which may be used by the theft monitoring system **10** to determine the identification of the tagged item **11** and identify a theft incident of the tagged item **11**.

In certain embodiments, detector data **12** may be transmitted to a database **36**, through a network **38**, or to cloud storage **40** either directly from the detectors **14** or from mobile devices **20** (e.g., smart phones, laptops, and so forth) communicatively coupled to the detectors **14**. In certain embodiments, detector data **12** may include data transmitted from a vehicle **42** and detected by a vehicle system **44**.

As described in greater detail herein, the theft monitoring system **10** may collect data from the various data sources (e.g., the data sources depicted in FIG. **1**) and perform various types of analysis to identify theft incidents for certain tangible tagged items **11** that are associated with the tags **16**. By way of example, FIG. **2** is a block diagram of example components of the theft monitoring system **10**. In particular, in certain embodiments, the theft monitoring system **10** may include various types of components that may assist the theft monitoring system **10** in performing the various functions described herein. For example, in certain embodiments, the theft monitoring system **10** may include a communication component **22**, a processor **24**, memory media **26**, storage media **28**, input/output (I/O) ports **30**, a display **32**, machine learning algorithms **34** that may be executed by the processor **24**, and so forth.

In certain embodiments, the communication component **22** may be a wireless or wired communication component that may facilitate communication between the theft monitoring system **10** and various devices via a network, the Internet, and so forth. For example, in certain embodiments, the communication component **22** may allow the theft monitoring system **10** to obtain the data from the variety of data sources, such as databases **36** (e.g., insurance database, database for list of tagged items **11** in certain areas), detector data **12** (either directly from detectors **14** or through a mobile device **20** or from a vehicle system **44**), cloud storage **40**, and so forth. In certain embodiments, the communication component **22** may receive and automatically send notifications to devices located in the property **18** or mobile devices associated with the user. In addition, in certain embodiments, the communication component **22** may use a variety of communication protocols, such as Open Database Connectivity (ODBC), TCP/IP protocol, Distributed Relational Database Architecture (DRDA) protocol, Database Change protocol (DCP), HTTP protocol, other suitable current or future protocols, or combinations thereof.

In certain embodiments, the processor **24** may process instructions for execution by the theft monitoring system **10**. The processor **24** may include single-threaded processor(s), multi-threaded processor(s), or both. In certain embodiments, the processor **24** may process instructions stored in the memory media **26**. The processor **24** may also include hardware-based processor(s), each including one or more cores. The processor **24** may include general purpose processor(s), special purpose processor(s), or both. The processor **24** may be communicatively coupled to other internal components of the theft monitoring system **10** (such as the communication component **22**, the storage media **28**, the I/O ports **30**, and the display **32**).

In certain embodiments, the memory media **26** and the storage media **28** may be any suitable articles of manufacture that can serve as media to store processor-executable code, data, and so forth. These articles of manufacture may represent computer-readable media (e.g., any suitable form of memory or storage) that may store the processor-executable code used by the processor **24** to perform the presently disclosed techniques. As used herein, applications may include any suitable computer software or program that may be installed onto the theft monitoring system **10** and executed by the processor **24**. The memory media **26** and the storage media **28** may represent non-transitory computer-readable media (e.g., any suitable form of memory or storage) that may store the processor-executable code used by the processor **24** to perform various techniques described herein. It should be noted that non-transitory merely indicates that the media is tangible, and not a signal.

In certain embodiments, the I/O ports **30** may be interfaces that may couple to other peripheral components such as input devices (e.g., keyboard, mouse, and so forth), the detectors **14**, input/output (I/O) modules, and so forth. In certain embodiments, the display **32** may operate as a human machine interface (HMI) to depict visualizations associated with software or executable code being processed by the processor **24**. In one embodiment, the display **32** may be a touch display capable of receiving inputs from an operator of the theft monitoring system **10**. The display **32** may be any suitable type of display, such as a liquid crystal display (LCD), plasma display, or an organic light emitting diode (OLED) display, for example. Additionally, in one embodiment, the display **32** may be provided in conjunction with a touch-sensitive mechanism (e.g., a touch screen) that may function as part of a control interface for the theft monitoring system **10**. It should be noted that the components described above with regard to the theft monitoring system **10** are examples and the theft monitoring system **10** may include additional or fewer components relative to the illustrated embodiment.

Referring back to the FIG. **1**, in certain embodiments, the theft monitoring system **10** may be communicatively coupled to a network **38**, which may include collections of theft monitoring systems, the Internet, an Intranet system, and so forth. The network **38** may facilitate communication between the theft monitoring system **10** and various other data sources. For example, the network **38** may be communicatively coupled to the detectors **14**. In certain embodiments, the detectors **14** correspond to one or more sensors or devices associated with (and, in certain embodiments, directly coupled to) tags **16**. Although the detectors **14** are described herein as being communicatively coupled to the theft monitoring system **10** via the network **38**, it should also be noted that, in other embodiments, the detectors **14** may be communicatively coupled directly to the theft monitoring system **10**.

In certain embodiments, the network **38** may also be communicatively coupled to databases **36**, which may store data relating to the user and/or the property **18**, such as insurance records, theft incident records, historical detector data, list(s) of tagged items **11** in areas, and other information that may be relevant for determining a theft incident, an insurance policy and/or insurance coverage, and so forth. In certain embodiments, the network **38** may be communicatively coupled to cloud storage **40**, which may store data relating to the user and/or the property **18** that may be relevant for determining a theft incident, an insurance policy and/or insurance coverage, and so forth. In addition, in certain embodiments, the network **38** may further be communicatively coupled to mobile devices **20** and/or a vehicle system **44** associated with the vehicle **42**.

In certain embodiments, the detectors **14** may monitor each tag **16** associated with particular items **11** located within the property **18**. The detectors **14** may detect motion data, location data, RFID data, beacon data, sound data, image data, and so forth. By way of example, in certain embodiments, the detectors **14** may include beacon detectors configured to detect signals from beacons inside the tags **16**. In certain embodiments, the detectors **14** may include RFID readers detecting RFID tags **16**. In certain embodiments, the theft monitoring system **10** may receive lists of tagged items **11** in areas from the mobile devices **20**, the storage media **28**, the database **36**, the network **38**, the cloud storage **40**, or other data sources. In certain embodiments, the theft monitoring system **10** may use the communication component **22** to receive detector data **12** generated by the detectors **14**, and may store the detector data **12** in the database **36** and/or the cloud storage **40**.

In certain embodiments, the theft monitoring system **10** may determine identification information of tagged items **11** in an area based on the detector data **12** acquired by the detectors **14**. The theft monitoring system **10** may receive location data of the detectors **14** from the detectors **14** or other sources (e.g., storage, or user input). The theft monitoring system **10** may generate an item area map based on the detector data **12** and the location data of the detectors **14**. The item area map may include identification information and location information of tagged items **11** within the area. In certain embodiments, a theft incident may be determined by comparing the items on the item area map with tagged items **11** on a list of tagged items **11** in the area. By way of an example, in certain embodiments, a list of tagged items **11** in an area may include a TV, but an item area map generated by the theft monitoring system **10** may indicate that the TV is not currently in the area, which may indicate a theft incident of the TV inside the area. In certain embodiments, the theft monitoring system **10** may store the theft incident information (e.g., time of occurrence, identification information of missing tagged items **11**, and so forth) in the storage media **28**, the database **36**, and so forth.

In certain embodiments, the theft monitoring system **10** may automatically send notifications of the theft incident to certain devices (e.g., the mobile devices **20**, vehicle system **44**, and so forth). In addition, in certain embodiments, the theft monitoring system **10** may automatically send instructions to activate protective actions, such as activating an alarm system, or deactivating the missing tagged items **11** (e.g., TV block systems in smart TVs may automatically disable all television functions of the smart TVs when stolen). In certain embodiments, the theft monitoring system **10** may determine an insurance policy and/or coverage based on the theft incident information.

In addition, in certain embodiments, the theft monitoring system **10** may detect motion patterns of a particular item **11** based on detector data **12** and compare the detected motion patterns with a recommendation of motion patterns for the particular item **11** determined based on the particular item's functions, properties, circumstances, environment, and so forth. In certain embodiments, the location of the particular item **11** may not change for a period of time (e.g., one week or one month). For instance, a dishwasher installed in a household may not move under normal working conditions, and the theft monitoring system **10** may determine a corresponding recommendation of a motion pattern for the dishwasher. When the motion patterns detected by the theft monitoring system **10** agrees with the recommendation, the theft monitoring system **10** may determine that the tagged item **11** is working under normal condition.

In certain embodiments, the theft monitoring system **10** may automatically send a power saving signal to a tag **16** installed in or disposed on the tagged item **11** to instruct the tag **16** to operate in a power saving mode, such as use a smaller repetition rate to transmit signals (e.g., switching from transmitting signals every hour to every two hours). In certain embodiments, the tag **16** may receive the power saving signal from a detector **14**. As such, the tag **16**, which may be powered by a button cell, may consume less power and work for a longer period before it needs to change the button cell.

When the motion patterns detected by the theft monitoring system **10** do not agree with the recommendation, the theft monitoring system **10** may determine that the tagged item **11** is not working under normal working conditions. For instance, when the theft monitoring system **10** detects a dishwasher installed in a household moving, the theft monitoring system **10** may determine that the dishwasher is not working under normal working conditions (e.g., the dishwasher is being taken away from the household or there may be an earthquake). In addition, in certain embodiments, the theft monitoring system **10** may utilize machine learning algorithms **34** or other identifying techniques to determine or identify correlations between the motion patterns of a certain item **11** and environment of the area (e.g., earthquake, tornado, flooding, and so forth). The theft monitoring system **10** may automatically send notifications of the abnormal condition to devices. As such, protective actions may be activated in response to the notification, and insurance policy or coverage may be determined and/or adjusted accordingly.

In certain embodiments, the detector data **12** may be uploaded to the databases **36** and/or the cloud storage **40** for the theft monitoring system **10** to analyze using mobile devices **20**. In certain embodiments, one or more mobile devices **20** (e.g., smart phone) may be used to store the detector data **12**, and then upload the detector data **12** to the databases **36** and/or the cloud storage **40**. For example, the detector data **12** may be transmitted from the detectors **14** to one or more mobile devices **20**, and then the detector data **12** may be uploaded to the cloud storage **40** by the one or more mobile devices **20**. In certain embodiments, the detector data **12** may be uploaded to the databases **36** and/or the cloud storage **40** after the theft incident has occurred. For example, during a network outage, the detector data **12** may be transmitted (e.g., through Bluetooth) and stored on certain mobile devices **20**, and then uploaded to the databases **36** and/or the cloud storage **40** sometime later. In certain embodiments, the theft monitoring system **10** may be installed on mobile devices **20**, and the detector data **12** may be transmitted to the storage media **28** from the mobile devices **20**.

FIG. **3** illustrates a method **100** for detecting a theft incident based on data acquired from the data sources described in greater detail herein. The theft monitoring system **10** may perform operations described in greater detail herein via the processor **24** based on processor-executable code stored in the memory media **26** and/or the storage media **28**. The processor **24** may execute the processor-executable code to receive the detector data **12** and conduct analysis as described in greater detail herein. In certain embodiments, based on the monitoring and analysis, the theft monitoring system **10** may automatically send notifications or recommendations, activate protective actions, determine an insurance policy and/or coverage for a user, and so forth. Although the example method described in FIG. **3** is described in a particular order, it should be noted that the example method may be performed in any suitable order and is not limited to the order presented herein. It should also be noted that although each processing block is described below in the example method as being performed by the theft monitoring system **10**, other suitable theft monitoring systems may perform the methods described herein.

Referring now to FIG. **3**, at block **102**, the theft monitoring system **10** may receive a list of tagged items **11** in an area (e.g., property **18**) from the mobile devices **20**, the storage media **28**, the database **36**, the network **38**, the cloud storage **40**, or other sources (e.g., user input). For example, in certain embodiments, the theft monitoring system **10** may collect the list of tagged items **11** in an area from the user, such as from the user's insurance application. In certain embodiments, the theft monitoring system **10** may present a visualization that requests the user or some other individual to provide location information for certain items **11**. In certain embodiments, the list of tagged items **11** in the area may be determined at the initial setup of tags **16** for the area, or the list may be updated at some later time.

At block **104**, the theft monitoring system **10** may use the communication component **22** to receive detector data **12** generated by the detectors **14**. In certain embodiments, the detectors **14** may automatically send out a detecting signal and scan the area to detect reflected or scattered detecting signals from the tags **16** (e.g., RADAR, LIDAR, RFID reader, IR depth camera, and so forth). The reflected or scattered detecting signals may include information that may be used by the theft monitoring system **10** to determine identification information and location information of the tagged items **11**. Each tag **16** may be integrated in or disposed on a particular item **11** located inside the area. In certain embodiments, the tags **16** may emit signals comprising identification information of tagged items **11** or information that may be used by the theft monitoring system **10** to determine identification information of the tagged items **11**, and the detectors **14** may detect the signals and determine the location of the tags **16**. In certain embodiments, the detectors **14** may record a time stamp for the detected signals. In certain embodiments, in order to identify the particular tag **16**, signals from a particular tag **16** may be emitted at a predetermined repetition rate (e.g., every 1 hour, every 30 minutes, every 15 minutes, every 5 minutes, and so forth), may use a predetermined transmission frequency (e.g., 144 MHZ), may be modulated by frequency modulation (FM) or amplitude modulation (AM), and/or may be coded by other methods (e.g., digitally coded). In certain embodiments, the reflected or scattered detecting signals from tags **16** may be used to recognize the identification of the associated tagged items **11**. For instance, a reflected or scattered detecting signal of an IR depth camera from tags **16** may be used to determine the identification and the location of the associated tagged items **11**. In certain embodiments, the theft monitoring system **10** may utilize machine learning algorithms **34** or other identifying techniques to determine or identify a certain item **11** based on the reflected or scattered detecting signal. As such, the theft monitoring system **10** may determine identification information, location information, and detected time of the tagged items **11** in the area (e.g., property **18**) based on the detector data **12**.

After receiving detector data **12** generated by the detectors **14**, at block **106**, the theft monitoring system **10** may generate an item area map for the tagged items **11** in the area based on the received detector data **12**. The item area map may comprise identification information and location information of the tagged items **11** in the area, and/or detected time of the tagged items **11**. The theft monitoring system **10** may use the detector data **12** to determine the identification information, the location information, and the detected time of the tagged items **11**.

In certain embodiments, the theft monitoring system **10** may use network traffic data received from network devices (e.g., routers) to generate an item area map (i.e., item network identification associated with virtual network address) for tagged items **11** using the network connections in the area. For example, in certain embodiments, network traffic data packets received by the theft monitoring system **10** may include a MAC address, such that a first portion of

the MAC address may indicate that a particular vendor (e.g., manufacturer) is associated with the particular item **11** (and/or associated tag **16**) and a second portion of the MAC address may indicate that the particular item **11** (and/or associated tag **16**) corresponds to a particular type of device (e.g., tablet). As such, the MAC address may indicate to the theft monitoring system **10** the particular type of tagged item **11** (and/or associated tag **16**) being detected.

At block **108**, the theft monitoring system **10** may identify a particular item **11** on the list of tagged items **11** missing in the area based on a comparison between the tagged items **11** on the generated item area map and tagged items **11** on the received list of tagged items **11** in the area. The theft monitoring system **10** may compare the tagged items **11** on the received list of tagged items **11** in the area with the tagged items **11** on the item area map for the area to determine whether a tagged item **11** on the list of tagged items **11** is missing. After making the comparison, in certain situations, the theft monitoring system **10** may determine that some of the detector data **12** is not related to the identifying of the particular item **11** in the area and, thus, refrain from evaluating the respective portion of the detector data **12** for future analysis.

After identifying the particular item **11**, at block **110**, the theft monitoring system **10** may collect information of the particular item **11**, such as identification information, location information, detected time, and so forth. In certain embodiments, the theft monitoring system **10** may store the collected information in storage, such as in the storage media **28**, the database **36**, and so forth. The theft monitoring system **10** may continuously monitoring the tagged items **11** inside the area and update the information of the missing tagged items **11**. For instance, a particular item **11** may be returned to the area after a certain time period, and the theft monitoring system **10** may update the information of the particular item **11** in the storage.

FIG. **4** illustrates a method **120** for confirming a theft incident of a particular item **11** identified missing above in FIG. **3**. The theft monitoring system **10** may confirm the theft incident of the particular item **11** by searching for it in other item area maps, such as item area maps generated for different areas (e.g., other rooms, other buildings, vehicles, and so forth) or item area maps generated based on data from different sources (e.g., network devices, network service providers, GPS, and so forth). The theft monitoring system **10** may perform operations described herein via the processor **24** based on processor-executable code stored in the memory media **26** and/or the storage media **28**. The processor **24** may execute the processor-executable code to receive the detector data **12** and conduct analysis as described in greater detail herein. Based on the monitoring and analysis, the theft monitoring system **10** may automatically adjust devices based on the information of the particular item **11**, update the list of tagged items **11** in the area, determine one or more insurance policy decisions based on the information of the particular item **11**, and so forth.

Although the example method in FIG. **4** is described in a particular order, it should be noted that the example method may be performed in any suitable order and is not limited to the order presented herein. It should also be noted that although each processing block is described below in the example method as being performed by the theft monitoring system **10**, other suitable theft monitoring systems may perform the methods described herein.

Referring now to FIG. **4**, at block **122**, the theft monitoring system **10** may receive information of a particular item **11** on a list of tagged items **11** in an area, wherein the particular item **11** is identified missing in the area by the theft monitoring system **10** using a first item area map for the area. The theft monitoring system **10** may receive the information of the particular item **11** from mobile devices **20**, the storage media **28**, the database **36**, the network **38**, the cloud storage **40**, the vehicle system **44**, or other sources (e.g., user input). In certain embodiments, the theft monitoring system **10** may receive information of the particular item **11** from a user, such as from the user's insurance claim. In certain embodiments, the theft monitoring system **10** may present a visualization that requests the user or some other individual to provide information for the particular item **11**.

At block **124**, the theft monitoring system **10** may receive a second item area map that may be generated based on data from sources other than the sources used to generate the first item area map, such as detector data **12** from other areas (e.g., other room, other building) or data from other sources (e.g., network devices, network service providers, GPS, and so forth), and the second item area map may be generated for the same area as the first item area map or for a different area. For instance, in certain embodiments, the first item area map may be generated for the property **18** using the detector data **12** received from detectors **14** inside the property **18**, and the second item area map may be generated for an area other than the property **18** using detector data **12** received from detectors **14** outside of the property **18**, such as detectors **14** in other rooms or other buildings, detectors **14** in mobile devices **20** outside of the property **18** (e.g., smart phone or smart watch travelling with the user), or detectors **14** in vehicles **42** outside of the property **18**. In other embodiments, the second item area map may also be generated for the property **18** using data from other sources (e.g., GPS data). In addition, in certain embodiments, the second item area map may be generated for a network in the property **18** using data received from network devices. For instance, a smart device identified missing from the property **18** may be found in a network to which it is communicatively connected.

At block **126**, the theft monitoring system **10** may search the information of the particular item **11** in the second item area map. For example, if the particular item identified missing in the property **18** is found on the second item area map generated by detector data received from a detector **14** in a mobile device **20** travelling with an owner of the property **18**, a theft incident may not have occurred (i.e., the owner may have taken the tagged item **11** from the property **18**). The owner may take the particular item **11** with him, put it in a vehicle **42** or in other locations (e.g., other buildings, and so forth). The theft monitoring system **10** may receive detector data **12** for other areas directly, or through mobile devices **20**, the network **38**, the cloud storage **40**, or from the vehicle system **44**. For instance, jewelry, cloths, shoes, accessories, or other wearable tagged items **11** may be tagged and tracked by the theft monitoring system **10** in the owner's property **18**. The owner may wear those tagged items **11** outside of property **18**, and the theft monitoring system **10** may track these tagged items **11** by using detector data **12** from other areas. For instance, if the particular item **11** is determined to be stolen or lost outside of the property **18**, rather than inside the property **18**, the insurance for the property **18** may not cover the particular item **11**. As such, the theft monitoring system **10** may help both an insurance company and the user to avoid false alarms and/or false insurance claims, or determine insurance claims more precisely.

At block **128**, the theft monitoring system **10** may automatically send notifications to devices after the theft monitoring system **10** determines that the particular item **11** is not found and that a theft incident may have occurred. For example, the theft monitoring system **10** may automatically send the notifications to a mobile device **20** or any other suitable device associated with the user. The notifications may cause the mobile device **20** to automatically launch or execute an application to provide a visual, audible, or haptic notification to the user. In this way, the user may be notified in substantially real time with respect to the detected theft incident.

At block **130**, the theft monitoring system **10** may send instructions to automatically adjust devices based on the identification information of the particular item **11**. In addition, in certain embodiments, the theft monitoring system **10** may send instructions to automatically activate protective actions, such as activating an alarm system, or deactivating the particular item **11** (e.g., TV block systems in smart TVs may automatically disable all television functions of the smart TVs when stolen). In addition, in certain embodiments, the theft monitoring system **10** may send instructions to automatically adjust operations of certain devices that are related to the aftermath of the theft incident. For instance, the theft monitoring system **10** may send instructions to an automatic floor cleaning device to cancel or reschedule a routine cleaning in an area when the theft monitoring system **10** determines a theft incident has occurred in the area, so that evidence of the theft incident may not be destroyed by the floor cleaning device. As such, the theft monitoring system may aid investigations of the theft incident (e.g., by police or an insurance company).

At block **132**, the theft monitoring system **10** may update the list of tagged items **11** in the area by using the information of the missing tagged item **11**. In certain embodiments, the theft monitoring system **10** may store the updated list of tagged items **11** in the area in storage, such as in the storage media **28**, the database **36**, the cloud storage **40**, and so forth. The theft monitoring system **10** may continuously update the list of tagged items **11** in the area.

At block **134**, the theft monitoring system **10** may determine one or more insurance policy decisions based on the information of the particular item **11**. In certain embodiments, the theft monitoring system **10** may automatically send the determined one or more insurance policy decisions to the user's devices.

While only certain features of the invention have been illustrated and described herein, many modifications and changes will occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

The techniques presented and claimed herein are referenced and applied to material objects and concrete examples of a practical nature that demonstrably improve the present technical field and, as such, are not abstract, intangible or purely theoretical. Further, if any claims appended to the end of this specification contain one or more elements designated as "means for [perform]ing [a function] . . . " or "step for [perform]ing [a function] . . . ", it is intended that such elements are to be interpreted under 35 U.S.C. 112(f). However, for any claims containing elements designated in any other manner, it is intended that such elements are not to be interpreted under 35 U.S.C. 112(f).

The invention claimed is:

1. A system, comprising:

one or more detectors configured to generate detector data based on signals received from one or more tags integrated in or disposed on one or more items; and a theft monitoring system comprising a processor configured to:

receive a first portion of the detector data generated for a first location associated with a user from the one or more detectors;

determine a first set of identification information corresponding to a first item of the one or more items based at least in part on the first portion of the detector data;

receive a list of tagged items for the first location, wherein the list of tagged items comprises a second set of identification information corresponding to the one or more items;

in response to determining that the first item is missing from the first location based on a first comparison of the first set of identification information and the second set of identification information, receive a second portion of the detector data for a second location associated with the user from the one or more detectors, wherein the second location comprises a vehicle associated with the user;

determine a third set of identification information corresponding to the first item based at least in part on the second portion of the detector data;

in response to determining that the first item is missing from the second location based on a second comparison of the third set of identification information and the second set of identification information, identify a theft incident for the first item on the list of tagged items;

automatically control operating parameters of one or more cleaning devices associated with the first location or the second location in response to identifying the theft incident, wherein automatically controlling the operating parameters of the one or more cleaning devices comprises canceling or rescheduling routine cleaning operations to be performed by the one or more cleaning devices in one or more areas associated with the first location or the second location; and

determine one or more insurance policy decisions for the first item based on the theft incident.

2. The system of claim **1**, wherein at least one of the one or more detectors is located in the first location.

3. The system of claim **1**, wherein at least one detector of the one or more detectors is located in the second location different from the first location.

4. The system of claim **1**, wherein at least one detector of the one or more detectors is on a mobile device located in the second location different from the first location.

5. The system of claim **1**, wherein the one or more tags comprise a motion sensor, a RFID sensor, a location sensor, a sound sensor, an image sensor, a temperature sensor, an intelligent electronic device, a beacon, or some combination thereof.

6. The system of claim **1**, wherein the one or more detectors comprise a motion detector, an RFID reader, a beacon detector, a sound detector, a RADAR, a LIDAR, an IR depth camera, or some combination thereof.

7. The system of claim **1**, wherein the processor is configured to:

receive network data comprising a fourth set of identification information corresponding to the first item from one or more network devices associated with a communication network;

identify the first item in the communication network based on a comparison of the first set of identification information and the fourth set of identification information; and

automatically send a notification indicating the first item in the communication network to one or more electronic devices.

8. The system of claim **7**, wherein the processor is configured to automatically adjust the operating parameters of the one or more cleaning devices in response to identifying the first item in the communication network.

9. A method comprising:

receiving a first portion of detector data from one or more detectors configured to receive signals from one or more tags integrated in or disposed on one or more items, wherein the first portion of the detector data is generated for a first location associated with a user;

determining a first set of identification information corresponding to a first item of the one or more items based at least in part on the first portion of the detector data;

receiving a list of tagged items for the first location, wherein the list of tagged items comprises a second set of identification information corresponding to the one or more items;

in response to determining that the first item is missing from the first location based on a first comparison of the first set of identification information and the second set of identification information, receiving a second portion of the detector data for a second location associated with the user from the one or more detectors, wherein the second location comprises a vehicle associated with the user;

determining a third set of identification information corresponding to the first item based at least in part on the second portion of the detector data;

in response to determining that the first item is missing from the second location based on a second comparison of the third set of identification information and the second set of identification information, identifying a theft incident for the first item on the list of tagged items;

automatically controlling operating parameters of one or more cleaning devices associated with the first location or the second location in response to identifying the theft incident, wherein automatically controlling the operating parameters of the one or more cleaning devices comprises canceling or rescheduling routine cleaning operations to be performed by the one or more cleaning devices in one or more areas associated with the first location or the second location; and

determining one or more insurance policy decisions for the first item based on the theft incident.

10. The method of claim **9**, wherein at least one of the one or more detectors is located in the first location.

11. The method of claim **9**, wherein at least one detector of the one or more detectors is located in the second location different from the first location.

12. The method of claim **9**, wherein at least one detector of the one or more detectors is on a mobile device located in the second location different from the first location.

13. The method of claim **9**, comprising:

receiving network data comprising a fourth set of identification information corresponding to the first item from one or more network devices associated with a communication network;

identifying the first item in the communication network based on a comparison of the first set of identification information and the fourth set of identification information; and

automatically sending a notification indicating the first item in the communication network to one or more electronic devices.

14. The method of claim **13**, comprising automatically adjusting the operating parameters of the one or more cleaning devices in response to identifying the first item in the communication network.

15. The method of claim **9**, wherein the one or more tags comprise a motion sensor, an RFID sensor, a location sensor, a sound sensor, an image sensor, a temperature sensor, an intelligent electronic device, a beacon, or some combination thereof.

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