OPERATION MANAGEMENT SYSTEM AND METHOD FOR TRIGGERING PERSONALIZED ACTION

BACKGROUND

[0001] Video systems and Wi-Fi are two common systems deployed in the real-estate sector (such as hotel, retails mall, office, airport, etc). Video systems are typically used for security management, such as monitoring and geo-fencing detection, etc. On the other hand, Wi-Fi system is typically used to provide internet access for the occupants.

[0002] It is known that due to the view angle and distance of a camera, it is difficult to capture a person's face using the the camera. In addition, thecamera usually has only limited coverage. Therefore, it is difficult to identify a person using video data. It is also known that Wi-Fi connection data is unable to detect scenes or actions of people.

[0003] To enable context-aware proactive operation, there are two main tasks, one is to detect scene (i.e. what happens), another is to associate the scene to a person. These tasks, however, cannot be achieved using only video data or Wi-Fi connection data.

SUMMARY

[0004] Therefore there is a need for a system to enable a context-aware proactive operation in real-estate management. This may be achieved by a combination usage of both video data and Wi-Fi connection data. Therefore, a new system and method that effectively use both video data and Wi-Fi connection data may be used to recognize context for proactive operation.

[0005] The present disclosure may be used to implement a hotel management system for better guest service, in which the system may automatically detect the ground scene and may

associate the scene to a guest, and may trigger proactive operation to provide personalized service for hotel guest.

[0006] The present disclosure may also be used to implement a hotel management system for better operation efficiency, in which the system may automatically detect number of guests and the guests' activity level, and may control the room temperature. The system may also automatically detect a guest is returning to the hotel, when a taxi is approaching to the hotel lobby, and may switch on the air-conditioning in guest room. The system may set the room temperature to the guest preferred temperature using historical room temperature settings by the guest.

[0007] The present disclosure may also be used to implement a hotel management system for better facility planning, in which the system may automatically detect the usage of facilities by guest profile (e.g., age, gender), and may optimize the number of facilities (e.g. gym equipment) based on the staying guests.

[0008] The present disclosure may also be used to implement a hotel management system for secured delivery service. Before a delivery staff enters the hotel, the system may automatically detect if the delivery staff wears mask, and may measure the body temperature of the delivery staff. When the delivery staff put the goods in front of the guest room and leaves, the system may automatically detect such context and may associate the context to the delivery staff detected at the hotel lobby. The system may notify the guest for example, through TV in the room, by showing how the goods is delivered from hotel lobby (including showing the video footage, temperature measured, etc.) to the guest room.

[0009] The present disclosure may also be used to implement a hospital management system for better patient care, in which the system may automatically detect if a patient falls down (or other specific scenes), and may inform the doctor-in-charge to ensure timely response to safeguard patient's life.

[0010] The present disclosure may also be used to implement an office building management system for close contact tracing, in which the system may automatically detect if a person has high body temperature (for example whereby a camera may capture thermal image as well), and may trace the close contacts.

[0011] These and other aforementioned advantages and features of the aspects herein disclosed will be apparent through reference to the following description and the accompanying drawings. Furthermore, it is to be understood that the features of the various aspects described herein are not mutually exclusive and can exist in various combinations and permutations.

[0012] The present disclosure generally relates to an operation management system for triggering a personalized action. The operation management system may include a scene detector which may be configured to detect a scene based on video analysis. The operation management system may also include a scene associator which may be configured to associate the scene to a person based on the video analysis and a location data of the person to determine an identity of the person, wherein the location data may be determined from a personal device of the person. The operation management system may also include a workflow manager which may be configured to trigger the personalized action based on the scene detected and the identity of the person.

[0013] The present disclosure generally relates to a method for triggering a personalized action. The method may include detecting a scene based on video analysis using a scene detector. The method may also include associating the scene to a person based on the video analysis and a location data of the person to determine an identity of the person using a scene associator, wherein the location data is based on the location of a personal device of the person. The method may further include triggering a personalized action based on the scene detected and the identity of the person using a workflow manager.

[0014] To the accomplishment of the foregoing and related ends, the one or more embodiments include the features hereinafter fully described and particularly pointed out in the claims. The following description and the associated drawings set forth in detail certain illustrative features of the one or more aspects. These features are indicative, however, of but a few of the various ways in which the principles of various aspects may be employed, and this description is intended to include all such aspects and their equivalents.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] In the drawings, like reference characters generally refer to the same parts throughout the different views. The drawings are not necessarily to scale, emphasis instead generally being placed upon illustrating the principles of the present disclosure. The dimensions of the various features or elements may be arbitrarily expanded or reduced for clarity. In the following description, various aspects of the present disclosure are described with reference to the following drawings, in which:

[0016] FIG. 1 illustrates an exemplary operation management system according to an embodiment of the present disclosure;

[0017] FIG. 2 illustrates an exemplary block diagram of components within the operation management system according to an embodiment of the present disclosure;

[0018] FIG. 3 illustrates an exemplary flow diagram of exemplary steps of a scene detection program according to an embodiment of the present disclosure;

[0019] FIG. 4 illustrates an exemplary feature database according to an embodiment of the present disclosure;

[0020] FIG. 5 illustrates an exemplary scene ontology decision tree according to an embodiment of the present disclosure;

[0021] FIG. 6 illustrates an exemplary scene assignment according to an embodiment of the present disclosure;

[0022] FIG. 7 illustrates an exemplary flow diagram of exemplary steps of a configuration program according to an embodiment of the present disclosure;

[0023] FIG. 8 illustrates an exemplary camera location table according to an embodiment of the present disclosure;

[0024] FIG. 9 illustrates an exemplary access point (AP) location table according to an embodiment of the present disclosure;

[0025] FIG. 10 illustrates an exemplary camera-AP mapping table according to an embodiment of the present disclosure;

[0026] FIG. 11 illustrates an exemplary connection log according to an embodiment of the present disclosure;

[0027] FIG. 12 illustrates exemplary dwell times of a phone at different access points according to an embodiment of the present disclosure;

[0028] FIG. 13 illustrates an exemplary flow diagram of exemplary steps of a phone-room mapping program according to an embodiment of the present disclosure;

[0029] FIG. 14 illustrates an exemplary phone-room mapping table according to an embodiment of the present disclosure;

[0030] FIG. 15 illustrates an exemplary flow diagram of exemplary steps of a phone-room re-mapping program according to an embodiment of the present disclosure;

[0031] FIG. 16A illustrates an exemplary AP-AP moving time diagram according to an embodiment of the present disclosure;

[0032] FIG. 16B illustrates an exemplary AP-AP moving time table according to an embodiment of the present disclosure;

[0033] FIG. 17 illustrates an exemplary flow diagram of exemplary steps of a scene association program according to an embodiment of the present disclosure;

[0034] FIG. 18A illustrates an exemplary workflow before associating scene information with room number according to an embodiment of the present disclosure;

[0035] FIG. 18B illustrates an exemplary workflow with scene information and room number according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0036] The following detailed description refers to the accompanying drawings that show, by way of illustration, specific details and embodiments in which the invention may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention. Other embodiments may be utilized and structural, and logical changes may be made without departing from the scope of the invention. The various embodiments are not necessarily mutually exclusive, as some embodiments can be combined with one or more other embodiments to form new embodiments.

[0037] Embodiments described in the context of one of the systems or server or methods or computer program are analogously valid for the other systems or server or methods or computer program and vice-versa.

[0038] Features that are described in the context of an embodiment may correspondingly be applicable to the same or similar features in the other embodiments. Features that are described in the context of an embodiment may correspondingly be applicable to the other embodiments, even if not explicitly described in these other embodiments. Furthermore, additions and/or combinations and/or alternatives as described for a feature in the context of

an embodiment may correspondingly be applicable to the same or similar feature in the other embodiments.

[0039] The word "exemplary" is used herein to mean "serving as an example, instance, or illustration." Any embodiment or design described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other embodiments or designs

[0040] In the context of various embodiments, the articles "a", "an", and "the" as used with regard to a feature or element include a reference to one or more of the features or elements.

[0041] As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0042] The terms "at least one" and "one or more" may be understood to include a numerical quantity greater than or equal to one (e.g., one, two, three, four, […], etc.). The term "a plurality" may be understood to include a numerical quantity greater than or equal to two (e.g., two, three, four, five, […], etc.).

[0043] The words "plural" and "multiple" in the description and the claims expressly refer to a quantity greater than one. Accordingly, any phrases explicitly invoking the aforementioned words (e.g. "a plurality of [objects]", "multiple [objects]") referring to a quantity of objects expressly refers more than one of the said objects. The terms "group (of)", "set [of]", "collection (of)", "series (of)", "sequence (of)", "grouping (of)", etc., and the like in the description and in the claims, if any, refer to a quantity equal to or greater than one, i.e. one or more. The terms "proper subset", "reduced subset", and "lesser subset" refer to a subset of a set that is not equal to the set, i.e. a subset of a set that contains less elements than the set.

[0044] The term "data" as used herein may be understood to include information in any suitable analog or digital form, e.g., provided as a file, a portion of a file, a set of files, a signal

or stream, a portion of a signal or stream, a set of signals or streams, and the like. Further, the term "data" may also be used to mean a reference to information, e.g., in form of a pointer. The term data, however, is not limited to the aforementioned examples and may take various forms and represent any information as understood in the art.

[0045] The term "processor" or "controller" as, for example, used herein may be understood as any kind of entity that allows handling data, signals, etc. The data, signals, etc. may be handled according to one or more specific functions executed by the processor or controller.

[0046] A processor or a controller may thus be or include an analog circuit, digital circuit, mixed-signal circuit, logic circuit, processor, microprocessor, Central Processing Unit (CPU), Graphics Processing Unit (GPU), Digital Signal Processor (DSP), Field Programmable Gate Array (FPGA), integrated circuit, Application Specific Integrated Circuit (ASIC), etc., or any combination thereof. Any other kind of implementation of the respective functions, which will be described below in further detail, may also be understood as a processor, controller, or logic circuit. It is understood that any two (or more) of the processors, controllers, or logic circuits detailed herein may be realized as a single entity with equivalent functionality or the like, and conversely that any single processor, controller, or logic circuit detailed herein may be realized as two (or more) separate entities with equivalent functionality or the like.

[0047] The term "system" (e.g., an operation management system, etc.) detailed herein may be understood as a set of interacting elements, the elements may be, by way of example and not of limitation, one or more mechanical components, one or more electrical components, one or more instructions (e.g., encoded in storage media), one or more controllers, etc.

[0048] A "circuit" as user herein is understood as any kind of logic-implementing entity, which may include special-purpose hardware or a processor executing software. A circuit

may thus be an analog circuit, digital circuit, mixed-signal circuit, logic circuit, processor, microprocessor, Central Processing Unit ("CPU"), Graphics Processing Unit ("GPU"), Digital Signal Processor ("DSP"), Field Programmable Gate Array ("FPGA"), integrated circuit, Application Specific Integrated Circuit ("ASIC"), etc., or any combination thereof. Any other kind of implementation of the respective functions which will be described below in further detail may also be understood as a "circuit." It is understood that any two (or more) of the circuits detailed herein may be realized as a single circuit with substantially equivalent functionality, and conversely that any single circuit detailed herein may be realized as two (or more) separate circuits with substantially equivalent functionality. Additionally, references to a "circuit" may refer to two or more circuits that collectively form a single circuit.

[0049] As used herein, "memory" may be understood as a non-transitory computer-readable medium in which data or information can be stored for retrieval. References to "memory" included herein may thus be understood as referring to volatile or non-volatile memory, including random access memory ("RAM"), read-only memory ("ROM"), flash memory, solid-state storage, magnetic tape, hard disk drive, optical drive, etc., or any combination thereof. Furthermore, it is appreciated that registers, shift registers, processor registers, data buffers, etc., are also embraced herein by the term memory. It is appreciated that a single component referred to as "memory" or "a memory" may be composed of more than one different type of memory, and thus may refer to a collective component including one or more types of memory. It is readily understood that any single memory component may be separated into multiple collectively equivalent memory components, and vice versa. Furthermore, while memory may be depicted as separate from one or more other components (such as in the drawings), it is understood that memory may be integrated within another component, such as on a common integrated chip.

[0050] The following detailed description refers to the accompanying drawings that show, by way of illustration, specific details and aspects in which the present disclosure may be practiced. These aspects are described in sufficient detail to enable those skilled in the art to practice the present disclosure. Various aspects are provided for the present system, and various aspects are provided for the methods. It will be understood that the basic properties of the system also hold for the methods and vice versa. Other aspects may be utilized and structural, and logical changes may be made without departing from the scope of the present disclosure. The various aspects are not necessarily mutually exclusive, as some aspects can be combined with one or more other aspects to form new aspects.

[0051] To more readily understand and put into practical effect, the present system, method, and other particular aspects will now be described by way of examples and not limitations, and with reference to the figures. For the sake of brevity, duplicate descriptions of features and properties may be omitted.

[0052] It will be understood that any property described herein for a specific system or device may also hold for any system or device described herein. It will also be understood that any property described herein for a specific method may hold for any of the methods described herein. Furthermore, it will be understood that for any device, system, or method described herein, not necessarily all the components or operations described will be enclosed in the device, system, or method, but only some (but not all) components or operations may be enclosed.

[0053] The term “comprising” shall be understood to have a broad meaning similar to the term “including” and will be understood to imply the inclusion of a stated integer or operation or group of integers or operations but not the exclusion of any other integer or operation or group of integers or operations. This definition also applies to variations on the term “comprising” such as “comprise” and “comprises”.

[0054] The term “coupled” (or “connected”) herein may be understood as electrically coupled or as mechanically coupled, e.g., attached or fixed or attached, or just in contact without any fixation, and it will be understood that both direct coupling or indirect coupling (in other words: coupling without direct contact) may be provided.

[0055] FIG. 1 illustrates an exemplary operation management system according to an embodiment of the present disclosure.

[0056] In an embodiment of the present disclosure, the operation management system 0110 may be used for triggering a personalized action. In an embodiment, the operation management system 0110 may include one or more processors. In an embodiment, the operation management system 0110 may include a non-transitory computer-readable medium. The non-transitory computer-readable medium may store a computer executable code which may include instructions for triggering a personalized action.

[0057] In an embodiment, the operation management system 0110 may include a video management system 0120. In an embodiment, the operation management system 0110 may include a plurality of CCTV cameras 0121. In an embodiment, the plurality of CCTV cameras 0121 may be connected to the video management system 0121.

[0058] In an embodiment, the operation management system 0110 may include an access point system. In an embodiment, the access point system may include a plurality of access points 0130. In an embodiment, the operation management system 0110 may include a plurality of personal devices 0131. In an embodiment, the plurality of personal devices 0131 may be connected to the plurality of access points 0130.

[0059] In an embodiment, the operation management system 0110 may include a communication network 0140. In an embodiment, the communication network 0140 may support various connectivity, such as Ethernet, Wi-Fi, BLE (Bluetooth Low Energy), Zigbee,

and various protocols, such as HTTP, RTSP, MQTT (Message Queueing Telemetry Transport), TCP/UDP.

[0060] In an embodiment, the plurality of personal devices 0131 may be connected to the plurality of access points 0130 through the communication network 0140. In an embodiment, the plurality of CCTV cameras 0121 may be connected to the video management system 0121 through the communication network 0140.

[0061] In an embodiment, a personal device 0131 may be a mobile phone or a wearable device. In an embodiment, the personal device 0131 may be moving and may connect to different access points. In an embodiment, the communication between a personal device 0131 and an access point 0130 may be via Wi-Fi, BLE, or others. To ease of explanation, in the present disclosure, a personal device may be a mobile phone, and the communication between a mobile phone and an access point (AP) may be via Wi-Fi but any suitable combinations may be used.

[0062] In an embodiment, the operation management system 0110 may include a scene detector. In an embodiment, the scene dectector may be or may include at least one of a unit, a circuit, or a program, for example a scene detection program. The program may include one or a plurality of instructions.

[0063] In an embodiment, the scene detector may be configured to detect a scene based on video analysis. In an embodiment, the operation management system 0110 may include a processor. In an embodiment, the processor may be in communication with the video management system 0120 or may be part of the video management system 0120. In an embodiment, a CCTV of the plurality of CCTV cameras 0121 may provide the video management system 0120 with a video data. In an embodiment, the processor may analyze the video data to determine if a scene is detected in the video. In an embodiment, the processor may detect if there are at least one of person features, belonging features, action, trajectory

and dwell time. In an embodiment, the scene detector may be configured to detect features of the scene. In an embodiment, the scene detector may be configured to check a scene ontology to determine if the scene is detected based on the features of the scene.

[0064] In an example, the processor may detect a person feature of a gender of the person, e.g., a male person, with a belonging feature of a luggage and an action of the person dragging the luggage. The processor may detect that there is a scene of a male person moving his luggage. From the trajectory of the person, the processor may determine if the male person is moving his luggage towards the hotel front desk or towards the hotel rooms.

[0065] In an embodiment, the operation management system 0110 may include a scene associator. In an embodiment, the scene associator may be or may include at least one of a unit, a circuit, or a program, for example a scene association program. The program may include one or a plurality of instructions.

[0066] In an embodiment, the scene associator may be configured to associate the person based on the video analysis and a location data of the person to determine the identity of the person. In an embodiment, the location data may be determined from a personal device of the person.

[0067] In an embodiment, scene associator may configured to associate the identity of the person to the scene.

[0068] In an embodiment, the access point system may be configured to detect a unique identification (ID) such as a phone ID of the personal device of the person. In an embodiment, the access point system may associate the identity of the person with the phone ID. In an embodiment, the access point system may be configured to determine the location data of the person based on an access point of the personal device of the person.

[0069] In an embodiment, the access point system may be configured to determine if the personal device is connected to an access point of a room for a predefined time. In an

embodiment, the access point system may be configured to associate the phone ID with the room if the personal device is connected to the access point of the room for the predefined time. In an embodiment, the predefined time may be at least 1 hour. In an embodiment, the access point system may determine if the personal device is connected to the access point of the room for the predefined time during a predefined time period. The predefined time period may be between 12 am to 6 am.

[0070] In an embodiment, the access point system may be configured to determine a moving time of the person based on a first connection time of the personal device to a first access point, and a second connection time of the personal device to a second access point. In an embodiment, the access point system may be configured to use the moving time of the person to determine the identity of the person. In an embodiment, the access point system may be configured to compare the moving time with a predetermined value in the database. In an embodiment, if the the moving time is within the predetermined value, there may be a higher likelihood that the person at a first location of the first access point is the same as the person at a second location of the second access point.

[0071] In an embodiment, the term "connection time" may include disconnection time. For example, the access point system may be configured to determine the moving time of the person based on a disconnection time of the personal device to the first access point and a connection time of the personal device to the second access point.

[0072] In an example, the processor may identify the identity of the person with the phone ID at the first access point. The first access point may be associated with a hotel room. From the hotel room, the processor may identify the identify of the person. When a scene happens in a location of the second access point, the processor may identify that the personal device with the phone ID is connected to the second access point. In an embodiment, the processor may compare a moving time with a predetermined value to determine if the person at a first

location of the first access point is the same as the person at a second location of the second access point.

[0073] In an embodiment, when the scene happens at the second location of the second access point, the scene associator may be configured to associate the identity of the person to the scene at the second location of the second access point.

[0074] In an embodiment, the operation management system 0110 may include a workflow manager. In an embodiment, the workflow manager may be or may include at least one of a unit, a circuit, or a program, for example a workflow management program. The program may include one or a plurality of instructions.

[0075] In an embodiment, the workflow manager may be configured to trigger the personalized action based on the scene detected and the person.

[0076] In an embodiment, the workflow manager may be configured to trigger the personalized action based on the scene detected and the identity of the person associated to the scene.

[0077] In an embodiment, the personalized action may include one of notifying a staff who speaks a same language as the person to go the location to assist the person, calling an elevator to go to a floor of the person, and switching on or off the air conditioner of the room associated with the person.

[0078] In an embodiment, the operation management system 0110 may check the database to determine features of the person. The features may include language that the person understands, the check in and/or check out date of the person, the preferred room temperature of the person, the preferred gym equipment of the person. Other suitable features may also be included.

[0079] In an example, the operation management system 0110 may determine that the person dragging the luggage is checking out and that the person speaks a certain language for

example English. The operation management system 0110 may notify a staff who speaks the same language as the person to go to the location to assist the person with the luggage. In another example, the operation management system 0110 may notify a staff who speaks the same language as the person to go to the front desk to assist the person with checking out.

[0080] FIG. 2 illustrates an exemplary block diagram of components within the operation management system according to an embodiment of the present disclosure.

[0081] In an embodiment, an operation management system 0110 may include, but is not limited to, a scene detection program 0111, a scene association program 0112, a phone-room mapping program 0113, an AP-AP moving time calculator program 0114, a workflow management program 0115, a configuration program 0116, and a database 0220. In an embodiment, the database 0220 may include, but is not limited to, camera location 0221, AP location 0222, Camera-AP mapping 0223, Wi-Fi connection log 0224, phone-room mapping 0225, AP-AP moving time 0226, feature database 0227, scene ontology 0228, and scene assignment 0229.

[0082] FIG. 3 illustrates an exemplary flow diagram of exemplary steps of a scene detection program according to an embodiment of the present disclosure.

[0083] In an embodiment, a scene detection program 0111 may be continuously executed for each CCTV camera. In step 0310, the operation management system 0110 may detect features in video frames from a CCTV camera. In step 0320, the operation management system 0110 may store features into a feature database 0227. In step 0330, the operation management system 0110 may look up a scene ontology that assigned to the CCTV camera. In step 0340, the operation management system 0110 may check if any scene detected. If yes, in step 0350, the operation management system 0110 may execute the scene association program 0112. The scene association program 0112 may associate the detected scene to a person.

[0084] FIG. 4 illustrates an exemplary feature database according to an embodiment of the present disclosure.

[0085] In an embodiment, the feature database 0227 may include a timestamp 0410. In an embodiment, the feature database 0227 may include a camera ID 0420. In an embodiment, the feature database 0227 may include a person features 0430. In an embodiment, the person features 0430 may include at least one of age 0431 (which may be value range), gender 0432, cloth 0433, and cloth colour 0434. Other suitable person features may be included.

[0086] In an embodiment, the feature database 0227 may include a belongings features 0440. In an embodiment, the belongings features 0440 may include at least one of an object 0441 and color 0442. Other suitable belongings features may be included.

[0087] In an embodiment, the feature database 0227 may include an action 0450. In an embodiment, the action 0450 may include at least one of walking, dragging an object, coughing and sneezing. Other suitable actions may be included.

[0088] In an embodiment, the feature database 0227 may include a trajectory 0460. In an embodiment, the trajectory 0460 may represent a person's movement direction within a CCTV camera view.

[0089] In an embodiment, the feature database 0227 may include a dwell time 0470. In an embodiment, the dwell time 0470 may be the length of time a person appeared within a CCTV camera view.

[0090] FIG. 5 illustrates an exemplary scene ontology decision tree according to an embodiment of the present disclosure.

[0091] The exemplary scene ontology decision tree of FIG. 5 may be derived from the exemplary feature database of FIG. 4.

[0092] A decision tree may be constructed based on features in the exemplary feature database of FIG. 4. In an embodiment, the features may include, but are not limited to, person features 0430, belonging features 0440, action 0450 and trajectory 0460.

[0093] In an example, for the scene ontology of checking out, the person features 0430 may include an age feature 0431, for example a person older than an age of 18 years. The belonging features 0440 may be an object feature 0441, for example a luggage. The action 0450 may be walking. The trajectory 0460 may be the direction of the hotel room to the elevator or the front desk, for example from the bottom right of the camera view to the upper left of the camera view. Other suitable features may be considered.

[0094] In an embodiment, multiple scene ontologies decision trees may be assigned to one CCTV camera. In an embodiment, the multiple scene ontologies decision trees may include, but are not limited to, checking in, checking out, using a gym equipment, coughing or sneezing. In an embodiment, each scene of the multiple scene ontologies decision trees may include a decision tree constructed based on possible features in the feature database 0227. In an embodiment, the operation management system 0110 may compare the features detected in step 0310 to features of the multiple scene ontologies stored in the database to determine which scene ontology is occuring.

[0095] FIG. 6 illustrates an exemplary scene assignment according to an embodiment of the present disclosure.

[0096] In an example of FIG. 6, the structure of a scene assignment 0229 may include, but is not limited to a camera ID 0610, a scene ontology 0620, a start time 0630, and an end time 0640. In the example, for camera ID CCTV1 with a scene ontology of checking out, the start time and/or end time may be set based on the hotel operation hour. For example, the start time may be set at 12 pm. The end time may be set to 18.30 pm.

[0097] In an embodiment, the scene assignment 0229 may have different start time 0630, and end time 0640 for different scene ontologies 0620.

[0098] FIG. 7 illustrates an exemplary flow diagram of exemplary steps of a configuration program according to an embodiment of the present disclosure.

[0099] In an embodiment, a configuration program may be executed by a system administrator. In an embodiment, one or more than one of a camera location 0221, AP location 0222, and a camera-AP mapping 0223 between camera and AP may be pre-configured via a configuration program 0116.

[00100] In step 0710, the operation management system 0110 may provide a user interface to configure the camera location 0221 for all CCTV cameras. In step 0720, the operation management system 0110 may provide a user interface to configure the AP location 0222 for all Wi-Fi APs. In step 0730, the operation management system 0110 may provide a user interface to configure the camera-AP mapping 0223. In step 0740, the operation management system 0110 may configure other parameters such as thresholds, time ranges, and weights via the configuration program. In an embodiment, the thresholds, time ranges, and/or weights may be configured based on different scene ontologies 0620.

[00101] FIG. 8 illustrates an exemplary camera location table according to an embodiment of the present disclosure.

[00102] In the example of FIG. 8, the structure of a camera location table 0221 may include, but is not limited to a camera ID 0810, a venue 0820, and a floor number 0830. As an example, CCTV1 may be located at the corridor of floor 7. As another example, CCTV2 may be located at the lift lobby of floor 5.

[00103] FIG. 9 illustrates an exemplary AP location table according to an embodiment of the present disclosure.

[00104] In the example of FIG. 9, the structure of an AP location table 0222 may include, but is not limited to an AP ID 0910, a venue 0920, and a floor number 0930. As an example, AP1 may be located at room 6 of floor 5 and may be abbreviated as R05-06 . As another example, AP2 may be located at the lift lobby of floor 5. As a further example, AP3 may be located at the corridor of floor 7.

[00105] FIG. 10 illustrates an exemplary camera-AP mapping table according to an embodiment of the present disclosure.

[00106] In the example of FIG. 10, the structure of a camera-AP mapping table 0223 may include, but is not limited to a camera ID 1010 and a corresponding AP ID 1020. In an embodiment, the area coverage of a camera ID 1010 may be within the area coverage of the corresponding AP ID 1020. As an example, since both CCTV1 and AP3 may be located at the corridor of floor 7, the operation management system 0110 may map CCTV1 and AP3 together. As another example, since both CCTV2 and AP2 may be located at the lift lobby of floor 5, the operation management system 0110 may map CCTV2 and AP2 together.

[00107] FIG. 11 illustrates an exemplary connection log according to an embodiment of the present disclosure.

[00108] In an embodiment, in order to associate a scene detected from a CCTV camera to a specific person, connection log 0224 of the corresponding AP may be used. In the example of FIG. 11, the structure of a connection log 0224 may include, but is not limited to a connection time 1110, a phone ID 1120, an AP ID 1130, and a disconnection time 1140. The dwell time of phone at a specific AP# (e.g., AP1) may be defined as, Dwell Time = Σ (Disconnection Time – Connection Time), where AP# = AP1.

[00109] FIG. 12 illustrates exemplary dwell times of a phone at different access points (APs) according to an embodiment of the present disclosure.

[00110] In an embodiment, the dwell time of a phone at different APs may vary as illustrated in FIG. 12. Based on the dwell time, a phone-room mapping program 0113 may associate a phone ID to a room number. In an embodiment, the operation management system 0110 may determine the AP with the maximum dwell time of a phone. In an embodiment, the operation management system 0110 may associate the phone ID of the phone with the AP at which the phone has the maximum dwell time. As an example, since the dwell time at AP1 is the maximum, the operation management system 0110 may associate the phone ID to room 6 at level 5 (R05-06), by referring to the AP location table 0222.

[00111] FIG. 13 illustrates an exemplary flow diagram of exemplary steps of a phone-room mapping program according to an embodiment of the present disclosure.

[00112] In the example of FIG. 13, after a guest check-in, in step 1310, the operation management system 0110 may detect a phone ID that first appears at a guest floor. In step 1320, the operation management system 0110 may check if a room number has been associated to the phone ID. If No, in step 1330, the operation management system 0110 may wait for a predefined time Δt (e.g., 1 hour). The predefined time Δt may be configured via step 0740 in the configuration program 0116. In step 1340, the operation management system 0110 may obtain the AP ID at which the phone ID has maximum dwell time during time Δt. In step 1350, the operation management system 0110 may check if the venue of the AP ID is a guest room, by checking the IP location table 0222. If yes, in step 1360, the operation management system 0110 may associate the room number to the phone ID.

[00113] FIG. 14 illustrates an exemplary phone-room mapping table according to an embodiment of the present disclosure.

[00114] In the example of FIG. 14, the structure of a phone-room mapping table 0225 may include but is not limited to a phone ID 1410, a room number 1420, and a floor number 1430.

As an example, the phone ID 112233445566 may be associated to room number R05-06 at floor 5.

[00115] FIG. 15 illustrates an exemplary flow diagram of exemplary steps of a phone-room re-mapping program according to an embodiment of the present disclosure.

[00116] The embodiment in FIG. 15 may be different from the embodiment in FIG. 13 in that in FIG. 15, a previous location information (e.g., a previous guest room number) has been associated with a particular phone ID, and FIG. 15 demostrates exemplary steps of changing the association of the phone ID from the previous location to a new location. In contrast, FIG. 13, there is no previous association between the phone ID and a location.

[00117] In an embodiment, a guest may request to change room after check-in, due to various reasons. In the example of FIG. 15, the exemplary steps of a phone-room mapping program 0113, may be executed at a specific time range ΔTR. In an embodiment, the specific time range ΔTR may be for example midnight 12:00am ~ 6:00am. In an embodiment, the specific time range ΔTR may be configured via step 0740 in the configuration program 0116.

[00118] In step 1510, for each phone ID in the phone-room mapping table 0225, the operation management system 0110 may obtain the AP ID in which the phone ID has maximum dwell time during time range ΔTR. In step 1520, the operation management system 0110 may check if the venue of the AP ID is different from the associated room of the phone ID. If yes, in step 1530, the operation management system 0110 may further check if the venue of the AP ID is a guest room. If yes, in step 1540, the operation management system 0110 may associate the room number to the phone ID.

[00119] FIG. 16A illustrates an exemplary AP-AP moving time diagram according to an embodiment of the present disclosure.

[00120] In an embodiment, the AP-AP moving time calculator program 0114 may calculate the moving time from a first AP to a second AP. In an embodiment, a moving time

may be calculated as the time between a phone ID disconnects from the first AP and then connects to the second AP.

[00121] FIG. 16B illustrates an exemplary AP-AP moving time table according to an embodiment of the present disclosure.

[00122] In an embodiment, the moving time may be an average value for all guests, or a value per guest basis. In an embodiment, the structure of an AP-AP moving time table 0226 may include but is not limited to a source AP ID 1610, a destination AP ID 1620, and a moving time 1630. In an embodiment, the moving time may be calculated as an average value for a guest. In an embodiment, the moving time may be calculated as an average value of a connection time at a second location subtracting the disconnection time at a first location. The moving time may be: Moving Time (AP#i, AP#j) = Avg (Connection Time at AP#j - Disconnection Time at AP#i).

[00123] FIG. 17 illustrates an exemplary flow diagram of exemplary steps of a scene association program 0112 according to an embodiment of the present disclosure.

[00124] In step 1701, the operation management system 0110 may obtain timestamp (t1) of features detected in the scene. In step 1702, the operation management system 0110 may obtain person features in the scene (e.g., age, gender, cloth, cloth color) from the feature database 0227. In step 1703, the operation management system 0110 may identify phone ID based on the Wi-Fi connection log at timestamp t1 from the corresponding AP ID of the CCTV camera, at which the scene is detected. In step 1704, the operation management system 0110 may obtain the room number associated to the phone ID, from the phone-room mapping table 0225. In step 1705, the operation management system 0110 may check if an associated room number found. If no, the program completes, and no action will be triggered. If yes, in step 1706, the operation management system 0110 may obtain time range [t2,t3] when guest last appeared at the lift lobby of guest floor, based on Wi-Fi connection log. In step 1707, the

operation management system 0110 may search person features in the feature database 0227, generated by the CCTV located at the lift lobby of guest floor within the time range [t2,t3]. In step 1708, the operation management system 0110 may calculate feature matching score (S1) based on search results in step 1707. In step 1709, the operation management system 0110 may measure the moving time between guest room and the lift lobby (immediate before or after [t2,t3]), using the connection log. In Step 1710, the operation management system 0110 may calculate the moving time matching score (S2), using the moving time in the AP-AP moving time 0226. In step 1711, the operation management

system 0110 may calculate the final score which may be $\sum Wi^* Si$, where Wi is a pre-configured

weightage for Si. In an embodiment, if more than 1 Phone ID is found in step 1703, then steps 1704 ~ 1711 should be executed for each phone ID, and the one with highest score will be selected. In step 1712, the operation management system 0110 may check if the final score is above a predefined threshold. If Yes, in step 1713, the operation management system 0110 may associate the scene to the room number, and may associate the scene to the person staying in the guest room.

[00125] In an embodiment, once a scene is associated to a room number, a workflow may be triggered with the room number and information from the scene. In an embodiment, details of scene (such as video image or location) and/or a confidence level which may be based on the matching score, may be provided to a system administrator to make further judgement before triggering the workflow. In an embodiment, if a guest profile, such as primary language of the person staying in the guest room can be provided (e.g., from a hotel guest management system), the workflow may be further improved for more personalized service to guest. For example, the workflow may be carried out by a staff who can speak guest's primary language.

[00126] FIG. 18A illustrates an exemplary workflow before associating scene information with room number according to an embodiment of the present disclosure.

[00127] In FIG. 18A, when a scene shows a person with a luggage moving towards an elevator, the system may determine that the person may be checking in or checking out depedning on a trajectory of the person. A corresponding action may be to call the elevator to go to the floor where the person is at (for example, the floor of his hotel room or the ground floor). Another action may be to inform front desk to start a check-out process if it is determined from the trajectory that the person is checking out.

[00128] In another example, another scene may show a person coughing, the system may determine that the person may be unwell. A corresponding action may be to get a staff to deliver medicine to the person or to make a phone call to check if any help is required. Another action may be to get a staff to isolate the unwell person from the rest of the people around (e.g., other hotel guests), to prevent spread of viruses and diseases.

[00129] In another example, another scene may show a guest may have problems using a new equipment, the system may determine that the guest may need help with the equipment, and may send a suitable staff to assist the guest. A suitable staff may be staff who possesses relevant knowledge such as equipment usage knowledege or language capability.

[00130] In another example, another scene may show a guest doing some sports activities such as using a gym equipment in the gym. The system may determine that the person may be interest in sporting events and may send a staff to promote the sporting events to the guest.

[00131] FIG. 18B illustrates an exemplary workflow with scene information and room number according to an embodiment of the present disclosure.

[00132] In an example, a guest may carry a luggage and may move towards the elevator. If the room number of the guest becomes available, then Front Desk staff may be informed in advanced to prepare the check-out bill proactively for the guest.

[00133] In another example, a guest may be coughing at the corridor. If the room number of the guest becomes available, then the hotel staff may make a phone call to the guest room at a proper time, to check if any help needed or to provide some common medicine.

[00134] In another example, a guest may have problems using a new equipment and may be looking around to seek help. If the room number of the guest becomes available, then a hotel staff who can speak the guest's primary language may approach to help.

[00135] In another example, a guest may be using a gym equipment in the gym. If the room number of the guest becomes available, the hotel may provide a personalized promotion (e.g. loyalty program or some fitness programs) to the guest.

[00136] While the present disclosure has been particularly shown and described with reference to specific aspects, it should be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the scope of the present disclosure as defined by the appended claims. The scope of the present disclosure is thus indicated by the appended claims and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced.

CLAIMS

What is claimed is:

1. An operation management system for triggering a personalized action, comprising:

a scene detector configured to detect a scene based on video analysis;

a scene associator configured to associate a person based on the video analysis and a location data of the person to determine an identity of the person, wherein the location data is determined from a personal device of the person; and

a workflow manager configured to trigger the personalized action based on the scene detected and the identity of the person.

2. The operation management system of claim 1, wherein the scene detector is configured to detect features of the scene, and the scene detector is configured to check a scene ontology to determine if the scene is detected based on the features of the scene.

3. The operation management system of claims 1 or 2, wherein the scene associator is configured to associate the identity of the person to the scene.

4. The operation management system of claim 3, wherein the workflow manager is configured to trigger the personalized action based on the scene detected and the identity of the person associated to the scene.

5. The operation management system of any one of claims 1-4, further comprising:

an access point system configured to detect a unique identification (ID) of the personal device of the person and associate the identity of the person with the unique ID.

6. The operation management system of claim 5, wherein the access point system is configured to determine the location data of the person based on an access point, wherein the personal device of the person is connected to the access point.

7. The operation management system of claim 5 or claim 6, wherein the access point system is configured to determine if the personal device is connected to an access point of a

room for a predefined time, and configured to associate the unique ID with the room if the personal device is connected to the access point of the room for the predefined time.

8. The operation management system of any one of claims 5-7, wherein the access point system is configured to determine a moving time of the person based on a first connection time of the personal device to a first access point, and a second connection time of the personal device to a second access point.

9. The operation management system of any of claims 1-8, wherein the features of the scene comprise at least one of person features, belonging features, action, trajectory, and dwell time.

10. A method for triggering a personalized action, comprising:

detecting a scene based on video analysis using a scene detector;

associating a person based on the video analysis and a location data of the person to determine an identity of the person using a scene associator, wherein the location data is based on an access point location of a personal device of the person; and

triggering the personalized action based on the scene detected and the identity of the person using a workflow manager.

11. The method of claim 10, further comprising: detecting features of the scene and checking a scene ontology to determine if the scene is detected based on the features of the scene, using the scene detector.

12. The method of claims 10 or 11, further comprising:

associate the identity of the person to the scene using the scene associator.

13. The method of claim 12, further comprising:

triggering the personalized action based on the scene detected and the identity of the person associated to the scene using the workflow manager.

14. The method of any one of claims 10-13, further comprising:

detecting a unique identification (ID) of the personal device of the person and associating an identity of the person with the unique ID, using an access point system.

15. The method of claim 14, further comprising determining the location data of the person based on an access point of the personal device of the person, using the access point system.

16. The method of claim 14 or claim 15, further comprising determining if the personal device is connected to an access point of a room for a predefined time, and associating the unique ID with the room if the personal device is connected to the access point of the room for the predefined time, using the access point system.

17. The method of any one of claims 14-16, further comprising determining a moving time of the person based on a first connection time of the personal device to a first access point, and a second connection time of the personal device to a second access point, using the access point system.

18. The method of any of claims 10 to 17, wherein the features of the scene comprise at least one of person features, belonging features, action, trajectory, and dwell time.

19. A non-transitory computer-readable medium storing a computer executable code comprising instructions for triggering a personalized action to any one of claims 1 to 18.

20. A computer executable code comprising instructions for triggering a personalized action according to any one of claims 1 to 18.