SMART GATE SYSTEM WITH THERMOMETER-CONTROLLED TERMINAL

Abstract

A smart gate system, and method, includes a thermal sensor for measuring a temperature of a visitor and transmitting the measured temperature, a QR code reader to read a health status QR code having a date range and transmitting a message including health status information of the visitor and a request for entry, a gate controller receiving a control signal for permitting or denying entry through a gate, a server for determining that the health status information and the temperature of the visitor indicate that the visitor has not contracted a predetermined virus and that the visitor is a registered visitor, and responding to the request for entry by transmitting the control signal to the gate controller in accordance with the determination and whether the health status QR code is within the predetermined date range, and the gate controller controlling opening of the gate based on the control signal.

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Appl. No.:	**19/186252**
Filed:	**April 22, 2025**

Related U.S. Application Data

parent US division 17895202 20220825 PENDING child US 19186252

Publication Classification

Background/Summary

BACKGROUND

Field of the Invention

[0002] The present disclosure relates generally to a smart portal system that can determine an individual's health identity including whether the individual(s) have received a particular vaccination, and determine whether the individual(s) are authorized to enter a restricted area, and in particular a portal system that can read the QR code of a Tawakkalna application to determine an individuals' vaccination status and measure current body temperature as prerequisite for authorization for entry.

Description of the Related Art

[0003] In order to enter any facility in the Kingdom of Saudi Arabia, it is required that a person establish that precautions against diseases such as the Covid-19 virus have been taken, for example by taking two doses of the vaccine, and that the vaccination be verified by a health identity through the "Tawakkalna" (aka Tawakulna) application, which appears in green on the screen of a mobile device, by appearance of the word immunized and/or a corresponding symbol or message. See Tawakkalna available at: ta.sdaia.gov.sa/index Sep. 20, 2021, incorporated herein by reference in its entirety.

[0004] A security person such as a health inspector or policeman can easily verify the health identity of an individual, but the process requires a long wait time, especially if the facility is big, such as in the case of a large university. It is advantageous that the health identity of each employee and student can be verified without delaying the start of work. Unfortunately, this would require the presence of many security persons. One solution is to use smart gates.

[0005] COVID-19 is a type of dangerous virus, and many people throughout the world have lived through difficult conditions during the spread of this virus and its variants. Unfortunately, the manual verification of health identity (e.g., vaccination status) requires the security person to be close to the individuals, which exposes the security person to the risk of contracting diseases, especially since the security person checks to ensure that a mask is worn and measures the body temperature.

[0006] However, a significant problem facing a high percentage of people who commute to work each day is traffic congestion that may be created or exacerbated by health checks at the entry points to different facilities, such as university campuses, supermarkets, hospitals, colleges, etc. This is due to the lengthy process of manual verification of health status. For instance, a campus gate may have a long line of traffic due to the manual health status check that takes a lot of time. As a consequence, due to the traffic congestion, staff and students will be late for work and classes.

[0007] Several approaches have been proposed to address the problems associated with verifying health identity of large groups of people. In 2020 a new method for smart doors that uses Bluetooth

to control the door's lock was introduced. This method is composed of three main elements. The first element is the overall design based on Bluetooth control that consists of many components such as the central controller, door lock controller, Bluetooth communication module, and system keyboard. The second element is the hardware design of the smart door lock. The third element is the software design, and it consists of the control software of the smart door and the Bluetooth software for the mobile client device. This method is efficient and flexible, and has shown to be economical. See Z. Mu, W. Li, C. Lou and M. Liu, "Investigation and Application of Smart Door Locks based on Bluetooth Control Technology," 2020 Asia-Pacific Conference on Image Processing, Electronics and Computers (IPEC), 2020, pp. 68-72, doi: 10.1109/IPEC49694.2020.9115189.

[0008] Also in 2020, an access control schema using WIFI bridges for a smart lock was presented. See Andrew Zhang and Raghavendra V. P. P. ICRAI 2020:2020 6th International Conference on Robotics and Artificial Intelligence November 2020 Pages 174-178https://doi.org/10.1145/3449301.3449331. This plan depends on WIFI bridges and a cloud server. It also uses A ES256 symmetric encryption, Bluetooth energy, and HTTPS communications to introduce an enhanced system that does not require physical monitoring or a human being's presence. The smart door has proven its successfulness as it provides 24/7 control and monitoring of the lock.

[0009] Still further in 2020, in order to overcome the weakness of a face recognition access control system, Bintang Wahyudono and Dion Ogi studied the possibility of implementing two authentication factors in one system. See B. Wahyudono and D. Ogi, "Implementation of Two Factor Authentication based on RFID and Face Recognition using LBP Algorithm on Access Control System," 2020 International Conference on ICT for Smart Society (ICISS), 2020, pp. 1-6, doi: 10.1109/ICISS50791.2020.9307564. FIG. **1** illustrates an RFID gate for controlling entry. Whyudono et al. implemented the system with two authentication factors of RFID **102** and face recognition based on a camera **104** using a local binary pattern algorithm. The access control system showed a major success using RFID with 100% authentication and 80% with face recognition with an average time of 0.03 seconds for RFID authentication and 6.3885 seconds for face recognition verification.

[0010] Also in 2020, Y aoqiu Hong designed an intelligent access control system using a DES-encrypted two-dimensional code. See Y. Hong, "Design of Intelligent Access Control System Based on DES Encrypted QR Code," 2020 IEEE International Conference on Advances in Electrical Engineering and Computer Applications (AEECA), 2020, pp. 1005-1008, doi: 10.1109/A EECA 49918.2020.9213475. System components consist of an embedded access control system, Android smartphone terminal, and server management terminal. When the embedded access control system receives the user's instruction after authentication, it controls an electric door switch after passing verification. Applications installed on the Android smartphone are responsible for generating and sending QR codes for authentication. The server controls the multi-doors and users and manages the permissions of all users. Specifically, the system workflow includes opening the access control app on the smartphone, generating encrypted QR code images, setting the phone against the embedded access control system, identifying QR codes via the camera, and allowing the door to open after authentication. The authenticated users can send one QR code image to the non-authenticated users via mobile phone, giving them one chance to open the door. To prevent the QR code from being copied, the QR code has an expiration date. When the time limit is exceeded, the QR code cannot be used to open the door. The server side is responsible for recording and storing people's access information and status. Using the server, the administrator can change a user's authority, control multiple doors, and achieve centralized management.

[0011] Moving to the year 2021 and using IoT technologies, scientists Stuti Mehra and others designed a special control system for hospitals, especially for the infant room, based on human face recognition technology and remote monitoring. See S. Mehra, A. Khatri, P. Tanwar and V. K hatri,

"Intelligent Embedded Security control system for Maternity ward based on IoT and Face recognition," 2018 International Conference on Advances in Computing, Communication Control and Networking (ICACCCN), 2018, pp. 49-53, doi: 10.1109/ICA CCCN.2018.8748516. The system regulates the entry of a person according to identity and gender, which helps provide security. The system works by using a face detection and recognition algorithm and ZigBee to find the person's identity. Then, another wireless interface is used to update the database in case there is a new person. If there is a new person, another alert message is sent. The system consists of a camera and a smart lock. The camera recognizes the person. The Face Recognition first sees whether the person is male/female. If the face is male, then the visitor waits for the visitation hours that are available for visiting the patient. If the sensor detects that the person is female and pregnant, then the system allows them to enter. If the person is a doctor, then the system checks the database for information about the doctor. The system checks IDs that are taken using the RFID technique and compares the IDs with their database. If the information in the IDs matches information in the database correctly, then the gate opens, otherwise not.

[0012] One approach to automatic access control has been to implement access control using a circuit board. In 2020, Jianfeng Y el proposed a method to set the lighting level, which is composed of a relay to control the ambient lighting level of the camera and a stepper motor to control the lighting of the curtain. See J. Y e, "Design and Implementation of Entrance Guard System Based on Face Recognition," 2020 International Conference on Virtual Reality and Intelligent Systems (ICV RIS), 2020, pp. 419-422, doi: 10.1109/ICVRIS51417.2020.00105. FIG. **2** illustrates a circuit diagram of a fingerprint biometric access control. The circuit **200** uses feedback from pre-processing of the picture and lighting level settings to control the adaptive lighting level of the objects in the captured image. The method is convenient and straightforward in design, exceptionally reliable, and easy to install. In conjunction with a PC, a camera records images and performs facial recognition, supported by ultrasonic distance measurement and infrared recognition of the human body. With the access control circuit **200** equipped with an infrared counter **202**, the single-chip computer communicates with the PC through the USB serial port **204** to complete the coordinated operation of the access control and facial recognition system.

[0013] In addition, in 2021 scientists Terene Govender and Patrice U menne studied the possibility of implementing a secure smart gate system using fingerprint biometrics in conjunction with an Arduino Uno that is used to provide access to a home security gate. See T. Govender and P. U menne, "Design of a Fingerprint Biometric Access Control System with GSM Functionality," 2021 International Conference on Artificial Intelligence, Big Data, Computing and Data Communication Systems (icABCD), 2021, pp. 1-6, doi: 10.1109/icABCD51485.2021.9519320. The system contained the following: PC/IDE software, fingerprint modules, LED lights, servomotor, GSM module, LCD display, push buttons. If an unauthorized person tries to enter, the Arduino Uno microcontroller will send a text message to the security person or the owner of the house telling him that someone is trying to break in. When an authorized fingerprint is scanned, the system grants entry correctly. The test result was correct 71% of the time. If an unauthorized fingerprint is scanned, the system rejects access 100% of the time. Finally, when there is unauthorized access, the system sends an SM S correctly to the occupant's cellphone via the GSM module 89% of the time.

[0014] In 2021, scientists Dickey Dwi Putra et al. provided a solution in the form of Integrated COVID-19 Early Prevention Devices (INCEPS) which was proposed to prevent the spread of COVID-19 in a public area through an Al-based smart portal and website integration. See D. D. Putra, M. Febriyanto, M. M. Nadra, W. Shalannanda, E. R. Firzal and A. Munir, "Design of Smart-Gate Based on Artificial Intelligence Possibly for COVID-19 Early Prevention at Public Area," 2020 14th International Conference on Telecommunication Systems, Services, and Applications (TSSA, 2020, pp. 1-4, doi: 10.1109/TSSA 51342.2020.9310878. INCEPS can monitor community density in various places and can provide a reminder to the public for further adherence to health protocols recommended by the government. FIG. **3** illustrates a smart-gate based on Artificial

Intelligence for COVID-19 early prevention at a public area. The system consists of several components: an automatic gate **302**, a temperature sensor **304**, a tuned camera **306** for facial recognition, a disinfectant spraying box **308**, and a disinfectant gate **310**. When a person enters, their temperature is measured using the temperature sensor **304**, then the camera **306** determines whether the person is wearing a mask or not, and based on the result, the gate **302** is opened. Otherwise, an alarm will ring. The data is recorded in the (INCEPS) database and displayed at the site to determine the number of visitors at an entrance before going to it.

[0015] In most cases, smart gates verify the identity of visitors or verify the validity of their access. The verification process is generally not done correctly except when using a variety of different authentication techniques. Several types of authentication have been previously addressed in research. The search for authentication was customized using QR and barcode because the "Tawakkalna" application displays the health status through them. Facial recognition was used in the verification of the presence of masks.

[0016] The general definition of biometric technologies is the measure of a human being's pattern. Biometrics consists of two types. The first one is behavioral biometric, which uses the pattern of individual actions such as a signature. The other type is physiological biometrics, and it focuses on the pattern of something in the human body, like the fingerprint. In this invention, the focus is on physiological biometrics.

[0017] The world situation and obligations imposed by the Covid-19 virus on the world, including the requirement to wear masks on faces and social distance, have led to various approaches to implement these requirements. Baluprithviraj KN and others proposed, in research they conducted in 2021, an authentication system that recognizes faces and will not give access to anyone who does not wear a mask. See K. N. Baluprithviraj, K. R. Bharathi, S. Chendhuran and P. Lokeshwaran, "Artificial Intelligence based Smart Door with Face Mask Detection," 2021 International Conference on Artificial Intelligence and Smart Systems (ICA IS), 2021, pp. 543-548, doi: 10.1109/ICAIS50930.2021.9395807. FIG. **4** illustrates access control turnstiles with facial recognition biometrics. An AI-based smart device (e.g., Raspberry pi with AI model and camera) and system **402** is linked to an application on the phone **404** that can be controlled through the application. Also, scientists Akshay Duth and others have created a hardware portal that can detect signs of COVID-19 disease. See A. Duth, A. A. Nambiar, C. B. Teja and S. Y adav, "Smart Door System with COVID-19 Risk Factor Evaluation, Contactless Data Acquisition and Sanitization," 2021 International Conference on Artificial Intelligence and Smart Systems (ICA IS), 2021, pp. 1504-1511, doi: 10.1109/ICA IS50930.2021.9395875. Based on symptoms and results, the hardware portal can give access to an individual by using an OpenCV system. The hardware portal starts by checking for the presence of a mask using a Raspberry Pi module and a camera module. Then, the hardware portal checks the temperature. The customer needs not have to touch any of the surfaces, even for opening the door. The entire system is completely automatic and is completely contactless.

[0018] The foregoing "Background" description is for the purpose of generally presenting the context of the disclosure. Work of the inventors, to the extent it is described in this background section, as well as aspects of the description which may not otherwise qualify as prior art at the time of filing, are neither expressly or impliedly admitted as prior art against the present invention.

[0019] There remains a need to automate the process of entering various facilities and speed up the process. In conjunction, there is a need to limit the number of people in the facility, as well as to determine a number of people that would be allowed to enter.

SUMMARY

[0020] An aspect of the present disclosure is a smart gate system that can include a thermal sensor for measuring a temperature of a visitor and transmitting the measured temperature; a QR code reader to read a health status QR code and transmitting a message including health status information of the visitor in accordance with the health status QR code and a request for entry, the

health status QR code having a predetermined date range; a database system for receiving and maintaining the health status information and registered visitor information; a gate controller receiving a control signal for permitting or denying entry through a gate; a server for determining that the health status information and the temperature of the visitor obtained from the thermal sensor indicate that the visitor has not contracted a predetermined virus and that the visitor is a registered visitor, and responding to the request for entry by transmitting the control signal to the gate controller in accordance with the determination and whether the health status QR code is within the predetermined date range; and the gate controller controlling opening of the gate based on the control signal that permits entry through the gate.

[0021] A further aspect is a smart gate system for vehicles that can include at least one terminal having a thermometer and a QR code reader; a server for receiving a reading from the thermometer, and health status information and date range from the QR code reader, and determining authorization to enter through a gate based on the thermometer reading, the health status information, and the date range, and sending an confirmation signal indicating authorization to enter, or denying entry; a microcontroller for opening a gate based on the confirmation signal and based on an operation signal from a security terminal to allow a single vehicle to pass through the opened gate; and a timer to time a predetermined duration that the gate remains open.

[0022] A further aspect is a smart gate system that can include a smart bracelet device having a memory storing health information of a user wearing the smart bracelet device and a communication circuit; a mobile device having a communication circuit for communication with the smart bracelet device, and a display device for graphical and textual display; a QR code reader reading a health status QR code from the display device of the mobile device; a server for receiving a body temperature reading from the smart bracelet device, and health status information and date range from the QR code reader, and determining authorization to enter through a gate based on the body temperature reading, the health status information, and the date range, and sending an authorization signal indicating authorization to enter, or denying entry; a microcontroller for opening a gate based on the authorization signal to allow the user wearing the smart bracelet device to pass through the opened gate; and a timer to time a predetermined duration that the gate remains open.

[0023] The forgoing general description of the illustrative implementations and the following detailed description thereof are merely exemplary aspects of the teachings of this disclosure, and are not restrictive.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate one or more embodiments and, together with the description, explain these embodiments. The accompanying drawings have not necessarily been drawn to scale. Any values dimensions illustrated in the accompanying graphs and figures are for illustration purposes only and may or may not represent actual or preferred values or dimensions. Where applicable, some or all features may not be illustrated to assist in the description of underlying features.

[0025] The characteristics and advantages of exemplary embodiments are set out in more detail in the following description, made with reference to the accompanying drawings. In the drawings:

[0026] FIG. **1** illustrates an RFID gate for controlling entry;

[0027] FIG. **2** illustrates a circuit diagram of a fingerprint biometric access control device;

[0028] FIG. **3** illustrates a smart gate for COVID-19 early prevention at a public area;

[0029] FIG. **4** illustrates access control turnstiles with facial recognition biometrics;

[0030] FIG. **5** illustrates a QR code reader apparatus;

[0031] FIG. **6** illustrates a smart gate system configured with hardware interfaces in accordance with exemplary aspects of the disclosure;

[0032] FIG. **7** is a block diagram for a smart gate system in accordance with exemplary aspects of the disclosure;

[0033] FIG. **8** is a flowchart for the operation of the smart gate system of FIG. **6**;

[0034] FIG. **9**A is a schematic diagram of an exemplary smart gate system in accordance with exemplary aspects of the disclosure;

[0035] FIG. **9**B shows an embodiment of the invention in which a forehead temperature sensor is covered with a spooled protective sheet;

[0036] FIG. **9**C shows a front view of the embodiment shown in FIG. **9**B showing a protective sheath material covering a front surface of a forehead temperature sensor;

[0037] FIG. **10** is a schematic diagram of another exemplary smart gate system in accordance with exemplary aspects of the disclosure;

[0038] FIG. **11** illustrates an arrangement of a smart gate system in accordance with exemplary aspects of the disclosure;

[0039] FIG. **12** is a diagram illustrating a smart gate system that utilizes a smart bracelet in accordance with exemplary aspects of the disclosure;

[0040] FIG. **13** is a data flow diagram for a smart gate system in accordance with exemplary aspects of the disclosure;

[0041] FIG. **14** is a detailed data flow diagram showing user interaction with the smart gate system in accordance with exemplary aspects of the disclosure;

[0042] FIG. **15** is a diagram of relationships among data entities in accordance with exemplary aspects of the disclosure;

[0043] FIG. **16** is a sequence diagram for a smart gate that verifies health identity of an administrator in accordance with exemplary aspects of the disclosure;

[0044] FIG. **17** is a sequence diagram for a smart gate that verifies health identity of all visitors in accordance with exemplary aspects of the disclosure;

[0045] FIG. **18** is a sequence diagram for a smart gate that verifies health identity of a security guard in accordance with exemplary aspects of the disclosure;

[0046] FIG. **19** is a sequence diagram for a case of verifying health identity in accordance with exemplary aspects of the disclosure; and

[0047] FIG. **20** is a block diagram of general components of a microcontroller.

DETAILED DESCRIPTION

[0048] The description set forth below in connection with the appended drawings is intended as a description of various embodiments of the disclosed subject matter and is not necessarily intended to represent the only embodiment(s). In certain instances, the description includes specific details for the purpose of providing an understanding of the disclosed embodiment(s). However, it will be apparent to those skilled in the art that the disclosed embodiment(s) may be practiced without those specific details. In some instances, well-known structures and components may be shown in block diagram form in order to avoid obscuring the concepts of the disclosed subject matter.

[0049] As used herein any reference to "one embodiment" or "some embodiments" or "an embodiment" means that a particular element, feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. The appearances of the phrase "in one embodiment" in various places in the specification are not necessarily all referring to the same embodiment. Conditional language used herein, such as, among others, "can," "could," "might," "may," "e.g.," and the like, unless specifically stated otherwise, or otherwise understood within the context as used, is generally intended to convey that certain embodiments include, while other embodiments do not include, certain features, elements and/or steps. In addition, the articles "a" and "an" as used in this application and the appended claims are to be construed to mean "one or more" or "at least one" unless specified otherwise.

[0050] Furthermore, the terms "approximately," "proximate," "minor," and similar terms generally refer to ranges that include the identified value within a margin of 20%, 10% or preferably 5% in certain embodiments, and any values therebetween.

[0051] Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout several views, the following description relates to a system and method for a smart portal system that can determine an individual's health state and whether they have got a particular vaccination, and then determine whether they are authorized to enter or not using a QR code and health state.

[0052] In most government, public and private institutions, there are two types of people who can enter: employees and visitors. What distinguishes the employees from the visitors is that the employees can access personal data registered in the employer's database, while the visitors typically have no personal data saved and/or do not have access to personal data. Under pandemic restrictions when a visitor enters an institution, the visitor is now to check body temperature, in addition to verifying the status of Covid-19 vaccination, in addition the individual submits to inspection by thermal camera to identify whether the individual is wearing a mask and/or is suffering a fever. Further, upon checking whether the person's temperature is in the normal range or not, an access gate can open and allow the person to enter or prevent entry. A problem with this approach is that a large percentage of security (e.g., a large human labor force and hardware footprint) is necessary to prevent unauthorized persons from entering the establishment.

[0053] The concept of a Unique QR code Identification (UQID) system has several potential uses, including improving hospitality solutions in hotels, access control in parking areas, and the development of more intelligent home automation technology. In the case of hotels, the correct QR code is used to unlock or keep the door locked accordingly. In the case of a hotel, the hotel can send the guest a QR code when they register for a room. That QR code is used as the key they need to access the room. FIG. **5** illustrates one example identification system that uses QR code for entry into a parking area. A QR reader **502** can scan the QR code for a vehicle **508**, or a person in the vehicle. A gate **506** may drop when an indicator lamp (LED lamp **504**) indicates that the QR code allows entry. In the case of home security solutions, QR code authentication promises to be one of the most accessible, user-friendly, and cost-effective. QR code authentication can replace conventional keys such as swipe cards or tokens and make authentication more practical. In addition to being cheaper than biometric systems, the UQID system enables good software security as well.

[0054] Offices have also increasingly been utilizing smart doors in the last decade. Due to the popularity of smartphones, there is a rising demand from consumers for the ability to do everything they need in their day-to-day lives through their mobile devices. Security is automated with the system, requiring little maintenance and monitoring. The UQID system provides security hardware and software solutions at lower costs and a more minimalistic design that is more welcoming to users and guests alike.

[0055] FIG. **6** illustrates a smart gate system configured with hardware interfaces in accordance with exemplary aspects of the present disclosure. In one embodiment, the smart gate system **600** is configured for verifying the identity and health status of a person in a vehicle **602**. The smart gate system **600** can detect whether there is more than one person in the vehicle **602**, in which case, the smart gate system **600** will require verification of health identity of all persons in the vehicle **602**. In an embodiment, the smart gate system **600** includes an infrared camera to detect the number of persons in a vehicle. In one embodiment, the smart gate system **600** is configured to verify health identity of persons in the vehicle from both sides of the vehicle **602**.

[0056] The smart gate system **600** includes a terminal **610**, having a display device **604** and a QR code reader **616**, as a connected tool. In one embodiment, there may be multiple terminals to accommodate multiple persons in a vehicle **602**. Data is transferred from the terminal **610** to a personal device **608** in the form of a QR code and the QR code reader **616** retrieves the health

status of the user by using the QR code as a unique identifier. The personal device **608** is connected to an external database server **606**. The connection to the external database server **606** is managed by the operating system of the personal device **608**, which may be a mobile phone or other portable display device. The terminal **610** includes a temperature sensor **610** to verify that the temperature of a person in the vehicle **602** does not exceed a threshold, e.g., greater than 38 degrees Celsius. The smart gate system **600** can include an emergency button **630**. In the case of the occurrence of an emergency or other problem, a person in the vehicle **602** can press the emergency button **630** to call and request a security person.

[0057] The smart gate system **600** includes a gate operation mechanism **622**. The gate operation mechanism **622** includes a motor unit for opening and closing a gate **620**, a controller for controlling the motor, a motion sensor, such as an infrared sensor or laser, for determining whether a vehicle is passing the gate **620** boundary, and a timer mechanism. In operation, the gate operating mechanism **622** may close the gate **620** based on the timer mechanism. In an embodiment, the closing process depends on timing by the timer mechanism that times out after a preset time such as 3 seconds, followed by a sensor that checks the passage of the vehicle **602** pass the opened gate **620**. If the vehicle **602** does not pass the opened gate within the 3 seconds, the timer restarts. The gate **620** is closed three seconds after the vehicle **602** has passed the gate **620**. A purpose of the timing mechanism is to control flow of vehicles through the smart gate so as smooth the flow of individuals entering the facility, as well as to prevent another vehicle(s) from passing through the smart gate without being verified. The time out setting of the timing mechanism may be adjustable and may be set at a different time out period.

[0058] In an embodiment, the gate **620** is a door that raises and lowers. The gate operating mechanism **622** may raise and lower the door.

[0059] It is advantageous to make sure that the smart gate system **600** remains secure. The smart gate system **600** is preferably configured such that nobody who is unworthy can enter the gate. In an embodiment, security is achieved when a certified security guard is present to ensure the gate is not opened by persons who do not meet the requirements (such as those without two doses of vaccination and an unstable temperature). Subsequently, if there is no authorized security person, or if the security guard's shift time has expired, the gate will be left in manual mode, and the gate will not be responsible for letting people in.

[0060] The smart gate system **600** includes a communication architecture arranged as a client-server model. In an example embodiment, the client is the smart gate terminal **610** which communicates with a back end server. In addition, a database server **606** can be accessed by the personal device **608** for obtaining information about the user's health status. The terminal **610** may include an access control system that reads the health status information of the user obtained from the database server **606**. Also, the health status information may be displayed in a display device of the terminal **610** as a web page using a web browser. In addition, communication between the personal device **608** and the smart gate terminal **610** needed to meet requirements for doing communication functions in the smart gate system **600** can include wireless communications such as Wi-Fi and Bluetooth.

[0061] FIG. **7** is a diagram of a relationship between components of a smart gate system in an exemplary hardware design.

[0062] (Microcontroller **702**) A microcontroller **702** is used to control the operation of the peripheral components connected to it to perform access control for the Smart Gate System as shown in FIG. **6**. In an exemplary embodiment, the microcontroller **702** of the Smart Gate System is an Arduino Uno or the like. The Arduino Uno is an open-source platform used for hardware programming. The Arduino Uno can be programmed to perform a particular function. In the exemplary embodiment, the Arduino Uno receives its commands from Smart Gate System software.

[0063] The microcontroller **702** may work in conjunction with a computer system **704** with

software for performing functions of the smart gate system, such as for transmitting health identification.

[0064] (Remote thermometer **706**) An important health factor is normal body temperature, and exceeding the normal body temperature may be an indicator of infection with various diseases or some pandemic viruses (such as the Covid 19 virus), so there is a temperature sensor device that measures the body temperature and checks that it is in the normal range for a human. In an exemplary embodiment, the temperature sensor device **706** can send the data to the Arduino Uno Microcontroller **702**.

[0065] (QR reader **708**) A QR code is a machine-readable optical label that contains information. A QR code is a square made up of small square patterns. The placement of these small squares encrypts the information in the QR code. After scanning, a QR code provides information. A QR Code Scanner/Reader **708** is an optical reader that can read QR codes. It is used in the smart gate system to read the QR code and verify the health status provided in the Tawakkalna application.

[0066] (Power key) In some embodiments, a power key may be provided to transfer the gate mode from an automatic mode to a manual mode.

[0067] (Timer **710**) A timing device **710** measures time and can issue a signal to a machine in order to start and stop operations at a specific time. The timing device **710** is used on the smart gate system to measure the time the gate will remain open for a car to pass the gate. See E. Wong, "Schneiderman's Eight Golden Rules will help you design better interfaces," Interaction-design.org. A vailable: www.interaction design.org/literature/article/shneiderman-s-eight-golden-rules-will-help-you-design-better-interfaces. [Accessed: 21 Nov. 2021]

[0068] (Help Button **714**) A help button **714** can function to provide assistance to users as quickly as possible to improve the efficiency of the smart gate system performance and responsiveness. When this help button **714** is pressed, an alert will be sent to the smart gate system to notify the security guards that there is an emergency case that needs help.

[0069] (Sensor **712**) Utilizing a sensor **712** embedded with the gate is used to control the opening operation. After a visitor satisfies all the conditions and allows the visitor to enter, the gate will open, and the timer will work. The sensor **712** will sense if there is an existing object, such as a vehicle or person, and let it pass. The timer will start upon detecting that the vehicle or person has passed. When the timer times out, the smart gate system will close the gate.

[0070] To facilitate control of entry into an establishment, the smart gate system can be used for individual persons and vehicles, meaning that the equipment can be a gate that accommodates large vehicles or just large enough to accommodate an individual person. The smart gate system may perform a check count (defined as: (current vehicle weight-original unladen vehicle weight)/normal human weight).

[0071] It is essential to make sure that the smart gate system always remains secure. It must be ensured that nobody who lacks permission or is unworthy is able to enter the gate. Enhanced security is achieved by a certified security guard that is present to ensure that the gate is not opened by persons who do not meet the requirements for entry (such as those without two doses of vaccination and an unstable temperature). In cases where there is no authorized security person, or if the security guard's shift time has expired, the gate will be left in manual mode, and the gate will not control access for people coming in.

[0072] The smart gate system provides easy operation, reliability, safety, and security. Security guards and administrative staff can rely on these easy-to-use features to ensure that the gate works the way they expect it to.

[0073] FIG. **8** is a flowchart for the operation of the smart gate system of FIG. **6**. It should be understood that although the steps of the flowchart are shown in a certain sequence, some steps may be performed in parallel or in a different order. For example, the step S**806** of reading the health status QR code from a display of a personal display device may be done in parallel with S**816** reading body temperature by the thermal sensor. In another example, the step S**816** of reading

body temperature may be performed as an initial step, such that a health status QR code is not transmitted to the personal display device.

[0074] In an embodiment, the smart gate system **600** uses a QR code reader **616** as a connected tool. The QR code reader **606** may scan/read a QR code by inserting (S**802**) a personal device **608** into a slot in the QR code reader **616** or placing the personal device **608** in a position for reading by the QR code reader **616**. In an embodiment, the QR code is an encrypted code to ensure that health status information is securely obtained and decoded by the reader. It should be noted that there may be situations where a user does not have a personal device **608**, or their personal device **608** is inoperable. This situation could occur when the user has misplaced their personal device **608**, does not own a personal device **608**, or the battery of the personal device **608** requires recharging. In such a situation, the user may obtain a printed QR code before arriving at the smart gate system **600**. In some embodiments, the security person or other official may assist the user in obtaining a printed QR code. The QR code reader **616** may be equipped to read a printed QR code.

[0075] In S**804**, the data will be transferred between the smart gate system **600** and the personal device **608** when the QR code is read to obtain the health status of the user. The connection of personal devices **608** to an external database server **606** is managed by the basic operating system on the personal device **608**, e.g., mobile phone. In S**806**, the health status of the user and a date range of the QR code is obtained when the QR code is read.

[0076] In S**808**, the QR code reader **616** obtains the time and date that the QR code reader scans/reads the QR code. In S**810**, the smart gate system **600** determines whether the current date is within the date range of the QR code. If it is determined that the current date is after the date range (NO in S**810**), In S**812**, the smart gate system will send a message indicating that entry through the gate is denied.

[0077] In a case that the current date is within the date range of the QR code (Y ES in S**810**), in S**822**, the smart gate system **600** will determine if the health status meets requirements for entry. If the health status does not meet the requirements for entry (NO in S**822**), in S**824**, the smart gate system will send a message indicating that entry through the gate is denied.

[0078] In S**826**, the body temperature sensor **614** (**706**) senses body temperature and, in S**828**, the smart gate system **600** verifies whether the temperature is at or below 38 degrees Celsius. If the detected body temperature is above 38 degrees Celsius, in S**830**, the smart gate system **600** denies entry of the user.

[0079] In an embodiment, in S**814**, in the case that an emergency or other problem, in S**816**, the user can press the emergency button **630** (**714**) to request a security person.

[0080] As for the gate closing mechanism **622**, the closing process depends on a timer mechanism **710** that measures time for a period of time, and a sensor **712** that checks the passage of an object pass the opened gate. In S**822**, provided that the user meets both health status and temperature requirements of S**828** and there is no emergency condition in S**814**, in S**832**, the gate will be opened for three seconds, in S**834**. In S**836**, the sensor **712** will detect whether the object has passed through the opened gate. If not, the timer mechanism will restart. Otherwise, in S**838**, the timer mechanism **710** starts over and, in S**840**, closes the gate after three seconds.

[0081] FIG. **9**A is a schematic diagram of an exemplary smart gate system in accordance with exemplary aspects of the disclosure. An example hardware implementation of the smart gate system **900** may include an arrangement that accommodates a touch free approach to simultaneously obtain a person's temperature while reading a QR code. The arrangement may include a mount **922** for placing a smartphone and a motorized adjustable stand having a temperature sensor **924** for obtaining temperature of a person's forehead. The QR code is read by the QR code reader **920** when the smartphone is placed in the mount **922**. The mobile device holder (mount **922**) provides positioning of the mobile device to read QR code. The position of the mobile device automatically adjusts to the reader, or the QR reader adjusts to the QR code displayed on the mobile device. The motorized adjustable stand automatically adjusts to the height of the person's

forehead to read the body temperature. A smart display **926** may display a pass or fail message to the user. In an embodiment, the smart display **926** may output a sound, to indicate that the forehead thermal sensor **924** is in the correct position to take a measurement, as well as to indicate pass or fail. Different sounds may be output for height adjustment and for pass or fail. A central microcontroller **902** may connect to the motorized adjustable stand, and in particular the thermal sensor **924** mounted on the stand, may connect to the QR reader **920**, a gate controllerl **910**, as well as a security or administrator terminal **904**, a database server **606**, and an external computer system **908**. The gate controler **910** may include a power source **912**, a help button **914**, an object detection sensor **916** and a timer **918**. The microcontroller **902** operates as an access control unit, while the gate controller **910** operates a gate.

[0082] In a preferable embodiment of the invention the forehead temperature sensor **924** is equipped with a spooled sheath screen protector to avoid contamination between use. For example, an individual using a forehead temperature sensor for measuring body temperature must makes physical contact with the forehead temperature sensor. This increases the risk that the individual may contaminate the sensor surface with a disease vector such as a bacterium or virus. Conventional forehead sensors are disinfected between uses. However, when embodied in the smart gate system of the present disclosure, disinfection by cleaning or disinfecting the contact surface with a disinfectant such as alcohol after each use is not practical.

[0083] Individual protective sheaths can be used for protecting temperature probes such as thermometers between uses. Each sheath is disposed after contact with an individual. This individual sheath strategy is not practical for inclusion in the smart gate system of the present disclosure because it requires a manual operator or a complex system for tearing away and replacing a contact sheath between uses. In FIG. **9**B a spooled sheath screen protector provides a means to cover the forehead temperature sensor **924** with a protective surface between uses without interruption or manual disinfection of the system. A spooled sheath screen protector preferably includes a supply spool **932** (9-101) mounted above and behind the plane of the forehead temperature sensor **924**. The supply spool **932** holds a rolled supply of protective sheath material **940** (9-110) for covering the contact surface of the forehead temperature sensor **924**. The supply spool **932** rotates in direction R. A take up spool **942** (9-102) is mounted below the temperature sensor and behind the plane of the contact surface of the forehead temperature sensor **924**. The take up spool **942** (9-102) functions to collect and re-spool protective sheath material **940** (9-110) that has contacted an individual during use. The take up spool **942** rotates in a direction R.

[0084] In one embodiment, the take up spool **942** may have an accompanying tension spool **952** to aid in pulling the protective sheath material **940** in a direction away from the forehead temperature sensor **924**. Downstream of the take up spool **942** may include a cutting edge **950** that aligns with the perforation between sheets of protective sheath material **940** to aid in separation of a sheet. A pair of pinching rollers **972** may be used to pull and separate a sheet **974** so that the sheet **974** may be disposed of in a direction D.

[0085] The supply spool **932** is adapted to hold a spool of disposable protective sheath material **940** (9-110). The protective sheath material **940** (9-110) is provided on the supply spool **932** (9-101) in the form of long rolled individual perforated sheets and is advanced onto the take up spool **942** after each use of the forehead temperature sensor **924**. The supply spool **932** (9-101) is equipped with a resistive despool decelerator **934** (9-111) such as a friction wheel to hinder uncontrolled or excessive release of the sheath. The take up spool **942** (9-102) is configured with a stepper motor **944** (9-112) that functions to rotate the take up spool thereby pulling a preset length of the protective sheath material from the supply spool after each use. The stepper motor is controlled by the microcontroller **902** to advance a preset length of protective sheath material **940** (9-110) such that the protective sheath material is retrieved onto the take up spool after completion of a forehead thermal sensor measurement. FIG. **9**C shows a front view of the spooled sheath screen protector system. The protective sheath material **940** (9-110) is preferably configured with a conductive path

954 (9-116) traveling longitudinally through its length, e.g., a length of conductive polymer or metallic thread. A capacitive sensor **960** (9-115) mounted on one or both of the supply spool **932** (9-101) or the take up spool **942** (9-102) makes electrical contact with the conductive path **954** (9-116) to measure and record a capacitance value. The capacitance value reflects contact between and individual and the protective sheath material during a measurement occurrence on the forehead thermal sensor **924**. The microcontroller **902** includes program instructions to advance the take up spool after a cycle of capacitive measurements which identify first contact of an edge of individual with the protective sheath material and separation of the individual from the protective sheath material and the forehead temperature sensor after a measurement event.

[0086] The micontroller **902** keeps a count of quantity of the protective sheath material and outputs a signal indicating a low level of the material below a predetermined level. The supply spool **932** and the take up spool **942** may each be replaced. The replacement may be performed manually, or using an automatic role feeder mechanism. In one embodiment, a shaft may be provided that can store additional supply spools **932**, where a replacement spool **932** is dropped into place as the mounted spool is dropped out.

[0087] In one embodiment, the gate is a door and the gate controller **910** controls a motor operated lock to lock or unlock the door.

[0088] FIG. **10** is a schematic diagram of another exemplary smart gate system in accordance with exemplary aspects of the disclosure. Different from the arrangement in FIG. **9**, the exemplary smart gate system utilizes cloud services **1004** for storage of health identification information of individuals, e.g., in a database service **1006**, and for access control via gate operation. The smart gate system may be interconnected with an internet router **1002**.

[0089] FIG. **11** illustrates an arrangement of a smart gate system in accordance with exemplary aspects of the disclosure. An exemplary smart gate system **600** includes a QR code reader **920**, as a connected tool, a thermometer **924**, and a sensor **712**. Data is transferred to a personal device **1110** including the Tawakkalna QR code and the QR code reader **920** retrieves the health status of the user based on the identification information that is encoded in the Tawakkalna QR code. The personal device **1110** is connected to an external database server **606**. The connection to the external database server **606** is managed by the operating system of the personal device **1110**, which may be a mobile phone or other portable display device. The thermometer **924** verifies that the temperature of a visitor does not rise and reach 38 degrees Celsius or more. The smart gate system **600** can include an emergency button **630**. In the case of the occurrence of an emergency or other problem, a visitor can press the emergency button **630** to call and request a security person.

[0090] The arrangement may include a mount **922** for placing a smartphone and a motorized adjustable forehead thermometer **924** that moves vertically along a stand **1102**. The Tawakkalna QR code is read by the QR code reader **920** when the smartphone **1110** is placed in the mount **922**. The motorized adjustable forehead thermometer **924** automatically adjusts to the height of the person's forehead to read the body temperature. The automatic adjustment of the forehead thermometer **924** may be directed with the aid of a camera **1104** that captures the image of a visitor's face. A smart display **926** may display a pass or fail message to the user. In one embodiment, the smart display **926** may include a speaker that will output a sound to indicate a pass or fail. In one embodiment, the smart display **926** which when the thermal sensor is automatically position adjusted to the position of the user's forehead, a sound is output by the speaker of the smart display **926** when the user's forehead is in a position of the thermal sensor.

[0091] In one embodiment, once the Tawakkalna QR code is read and indicates the minimum required health identity, the camera **1104** will activate to capture an image of the visitor's face and cause the adjustable forehead thermometer **924** to move to the position of the visitor's forehead. In the case that the Tawakkalna QR code indicates an insufficient health identity, the smart display **926** will display a fail message, and the gate **1106** will remain in a closed position. In a case that the Tawakkalna QR code has indicated a sufficient health identity, and the temperature measured

by the forehead thermometer **924** is within the required temperature range, the smart display **926** will display a pass message, and the gate **1106** will be moved to an open position.

[0092] In one embodiment, the Tawakkalna QR code is transmitted to a personal device **1110** each time a health event is recorded for the visitor. For example, a Tawakkalna QR code will be transmitted to the personal device **1110** when the visitor obtains a vaccination. A new Tawakkalna QR code may be transmitted when the visitor has another vaccination. If the visitor becomes infected and is diagnosed as such, another Tawakkalna QR code will be transmitted based on occurrence of that event.

[0093] In one embodiment, the Tawakkalna QR code is transmitted to a personal device **1110** when the visitor makes a request for the Tawakkalna QR code. The visitor may make a request for the Tawakkalna QR code when the visitor is in position to enter. The visitor may make a request for a QR code using the Tawakkalna App.

[0094] In one embodiment, the Tawakkalna QR code is transmitted to the personal device **1110** when the forehead thermometer **924** makes a measurement of the visitor's body temperature. If the measurement indicates that the visitor's body temperature exceeds a threshold temperature, thus indicating a fever, the QR code will not be transmitted, or instead of reading the QR code, a message, sound or visual alarm, or other communication will be made to indicate that the entry through the smart gate is denied.

[0095] In some embodiments, the Tawakkalna QR code will be given a date range, such that the QR code will expire after the end of the date range.

[0096] In some embodiments, the camera **1104** will capture an image of the visitor's face, and the smart gate system will use the captured image to authenticate the visitor. In such case, the Tawakkalna QR code will be transmitted to the personal device **1110** after the visitor is authenticated. The identification associated with the authenticated visitor will be paired with the QR code when the QR code reader reads the QR code.

[0097] The camera **1104** may be used to detect the presence of a face mask on the visitor's face, and the presence of the mask may be an additional factor used to allow or deny entry pass the gate.

[0098] FIG. **12** is a diagram illustrating a smart gate system that utilizes a smart bracelet in accordance with exemplary aspects of the disclosure. In an embodiment, if a user is an employee, the user can connect to the smart gate system **600** through a smart bracelet **1202** (or a smartwatch) equipped with Near Field Communication (NFC) technology **214**. The smart bracelet **1202** is configured to determine the health signs of the individual such as body temperature (thermometer **218**), blood oxygen percentage, and heart rate **216**, in addition to health status information stored in memory **212**, including vaccination information and other health status information. The smart bracelet **1202** may include a display device **220**. The smart gate system **600** checks for health identification through health status information transmitted from the smart bracelet **1202** (or the smartwatch) in conjunction with a mobile app **1204** that can display a Tawakkalna QR code that is read by a QR code reader **1206**.

[0099] The smart gate system **600** records the employee or student's entry time and may provide the employee or student with a medical excuse in case the person's vital signs indicate a problem. Health status data can be saved using a portal. The portal provides a facility with a function to print many types of reports, such as general visitor reports, ate opening times, the time of employee entry, and other types of reports for an administrative or security person to review.

[0100] In one embodiment, smart bracelet **1202** may communicate directly with the gate controller **702**, e.g., via NFC or Bluetooth, to signal the controller **702** to open the gate based on health status information previously stored in the smart bracelet **1202**. In the embodiment, health status information may be earlier obtained by a scan of a Tawakkalna QR code that meets the required health standards, and prestored in a memory of the smart bracelet **1202**. The health status information may have an associated expiration date range, in which the controller **702** will not open the gate when the date range of the health status information has expired.

[0101] In one embodiment, the gate is a door having a motor operated lock. The smart bracelet **1202** may communicate directly with the gate controller **702**, e.g., via NFC or Bluetooth, to signal the controller **702** to unlock the door based on health status information previously stored in the smart bracelet **1202**.

[0102] As an example of a smart bracelet, the Smart Bracelet "Nusk" of Saudi Arabia has been used for pilgrims for the hajj season during the pandemic. This smart bracelet **1202** contains information about the pilgrim's health, and if there was any possible exposure to COVID-19 and their health status, as well as the blood oxygen, heart rate, and emergency medical or any security assistance that it's equipped GPS technology can provide.

[0103] Users of the smart gate system may be divided into three categories: visitors, administrators, and security guards, each with different roles. A visitor is not always allowed to enter because they must meet the gate's conditions. An administrator's responsibilities include managing the conditions of the gate, appointing a security guard, ensuring the reports and database are accurate. In addition to providing support for the gate, the security guard must ensure that the smart gate system functions as intended and is open when a visitor completes these conditions. In addition, security guard may prepare reports and carry out the necessary checks to redress any problems encountered at the gate.

[0104] FIG. **13** is a data flow diagram (DFD) for the smart gate system. FIG. **13** illustrates an association between each user with the smart gate system. In FIG. **13** the DFD Context diagram contains the system entities (Admin **1312**, Security guard **1304** and Visitors **1306**) and their interaction with the smart gate system **1302** which is represented as a data flow between the entities and the system **1302**. In S**1352**, a visitor **1306** will be provided with a QR code from the Tawakkalna system **1308**. The QR code may be color coded as an indication of a visitor's movement status. Red means that the visitor cannot leave their premises. Yellow means that the visitor is quarantined for a certain period of time. Green means that the visitor is free to move. The color codes may indicate an immune class. In particular, a Dark Green Color code in Tawakkalna has three classes: (1) IM MUNE: the user has completed the doses of the Corona vaccine; (2) IM MUNE BY THE FIRST DOSE: the user has received a portion of the vaccines, and continues for 180 days; (3) IM MUNE BY RECOVERY: the user recovered from the infection and developed a natural immunity from the infection that lasts for six months. The Green Color indicates: No Record of Infection, and is declared healthy. Other colors may indicate that the user has been exposed to Covid 19 or has been infected by Covid 19.

[0105] In S**1354**, the QR code may be scanned by the smart gate system **1302**. The QR code contains information of a personal health condition, as of a date and time, e.g., immune status of the person.

[0106] In addition, the visitor **1306** will have body temperature measured by a thermometer system **1310**. In addition, in S**1358**, the visitor's body temperature will be transmitted to the smart gate system **1302**.

[0107] In S**1372**, a security guard **1304** may request to view visitor health information. In S**1374**, the security guard **1304** may view the visitor's health information status. In S**1356**, the smart gate system **1302** will provide a message confirming or denying entry by the visitor. In $**1376**, the security guard **1304** may request a gate mode transformation request to the smart gate system **1302**. In S**1378**, the smart gate system **1302** may send a confirmation message to the security guard **1304** to confirm the gate mode transformation request.

[0108] In an alternative use case, in S**1362**, the visitor **1306** may request help. In S**1364**, the smart gate system **1302** will provide a help response message to the visitor **1306**.

[0109] An administrator **1312** may perform various actions with the smart gate system **1302**, including, viewing and changing user information requests S**1382**, generating reports S**1384**, and authorizing a gate mode transformation request S**1386**. In response, the smart gate system **1302** may print reports S**1394** and send messages S**1392**, S**1396** to the administrator **1312**. The

administrator **1312** may be provided with information from the security guard **1304**, including, in S**1386**, a request for gate mode transformation.

[0110] FIG. **14** is a detailed data flow diagram showing user interaction with the smart gate system. In particular, FIG. **14** shows a more detailed DFD which illustrates how users interact with the system, how the system performs the process and where the data will be stored. In S**1422**, a visitor **1306** may obtain a QR code from the Tawakkalna system **1308**. In S**1358**, a thermometer **1310** will measure the visitor's body temperature. In S**1354**, a smart gate QR reader **1402** will scan the Tawakkalna QR code from a personal device of the visitor **1306**. In S**1426**, a visitor registration task **1406** will receive the visitor's body temperature from the thermometer **1310** and, in S**1424**, health status from the QR reader **1402**. The visitor registration task **1406** will check the health status and temperature against entry criteria, and determine whether to grant or deny entry of the visitor **1306**. In S**1428**, the visitor registration task **1406** will store the visitor's information in a database (**606**, **1006**), and, in S**1430**, the database (**606**, **1006**) will send a message to a gate operation task **1410**, that confirms that the gate may be opened.

[0111] In S**1432**, the security guard **1304** may send a request to view, edit, manage visitor information managed by a user's management task **1404**. The managed information of visitors is, in S**1460**, stored in the database **606**, **1006**. In S**1434**, the security guard **1304** may oversee and allow operation of the gate by the gate operation task **1410**. In S**1436**, an administrator **1312** may also oversee and allow operation of the gate by the gate operation task **1410**. In S**1438**, the gate operation task **1410** may send a message to the visitor **1306** that the gate will be opened and the visitor is allowed to go through the gate.

[0112] In one embodiment, in S**1440**, the visitor **1306** may send a request for help to an emergency task **1412**. In S**1442**, the emergency task **1412** sends a notification message to the security guard **1304**, and, in S**1444**, sends a convert mode command to a conversion mode task **1414**. In S**1446**, the security guard **1304** may send a message to authorize a change in mode to the conversion mode task **1414**. In S**1448**, the conversion mode task **1414** will then send a command to the gate operation task **1410** to operate the gate in the converted mode. In S**1438**, the gate operation task **1410** may send a message to the visitor **1306** that the gate will be opened and the visitor is allowed to go through the gate.

[0113] The administrator **1312** may request to view user information and view reports. In S**1450**, a user management task **1404** may receive a request to view, edit, manage user information and provide access to the user information stored in a database (**606**, **1006**), as well as, in S**1460**, save user information in the database (**606**, **1006**). In S**1452**, a reporting task **1408** may receive a request for a report, which, in S**1454**, will send a retrieve request to the database (**606**, **1006**) and receive, in S**1456**, and generate the requested report. In S**1458**, the reporting task **1308** will send the report to the administrator **1312**.

[0114] FIG. **15** is an entity relationship diagram for an example of data used in the smart gate system. The figure shows a relationship model for storing and managing all information retrieved by the system. Data is organized into entities within a database management system (**606**, **1006**) accompanied by their attributes. There is data about significant entities along with their attributes. In FIG. **15**, the entities are admin **1504**, security guards **1502**, and entry attempt entities **1506**. The database management system (**606**, **1006**) includes information about those entities and their attributes.

[0115] In an exemplary embodiment, attributes of the security guard **1502** can include name (first name, last name), start date, user name, password, a work ID, and a phone number. The attributes of the administrator **1504** can include name (first name, last name), start date, user name, password, a word ID and a phone number. The attributes of the entry attempt **1506** can include an ID, health status, verification result, and an entry time. Relationships can include one administrator **1504** manages M security guards **1502**; a security guard oversees M entry attempts **1506**; one administrator **1504** manages M entry attempts **1506**.

[0116] Sequence diagrams are provided to show how and in what order a group of objects works together. In addition, the sequence diagrams model the logic of a sophisticated procedure, function, or operation as well as show how objects and components interact with each other to complete a particular process. The following sequence diagrams illustrate the possible scenarios in the Smart gate system.

[0117] FIG. **16** is a sequence diagram for a case of verifying health identity of an admin user (administrator **1312**). The admin user **1312** can access the smart gate system **600** through a portal **1602**. In an embodiment, the portal **1602** is a Web interface that is provided on a terminal computer. The terminal computer may be any of a desktop computer, laptop computer, tablet computer, to name a few. The portal **1602** can include a sign in function **1612**, an edit profile function **1614**, a manage security personnel function **1616**, and a report request function **1618**.

[0118] In the sign in function **1612**, in S**1622**, an admin user **1312** can enter a username and password, and, in S**1624**, will receive a success message when the sign in is successful.

[0119] The admin user **1312** may have an associated user profile, which may be edited. The user profile may include a function to change a username and set a new password. The user profile may include personal data of the admin user **1312**. The admin user **1312** may, in S**1634**, choose a function to edit the user profile in the edit profile function **1614**, and, in S**1636**, save the changes in the database **606**, **1006**. In S**1638**, a message may be sent to the portal **1602** to verify that the changes to the user profile have been made.

[0120] In S**1626**, the admin user **1312** may use the manage security personnel function **1616** to add, modify, or delete security personnel data. In S**1630**, any changes made to the security personnel data may be saved in the database **606**, **1006**. In S**1632**, a message may be sent from the database **606**, **1006**, indicating that the changes have been saved successfully.

[0121] In S**1640**, the admin user **1312** may request periodic or ad hoc reports. The admin user **1312** may activate the report request function **1618**. In S**1642**, the report request function **1618** submits a retrieval instruction to the database **606**, **1006**. When the data is retrieved, in S**1644**, the database **606**, **1006** may send a message to the report request function **1618** indicating that the data has been obtained successfully. The report request function **1618** will generate the requested report and, in S**1648**, provide the generated report for viewing by the admin user **1312**.

[0122] FIG. **17** is a sequence diagram for a case of verifying health identity of a visitor with the aid of a security guard. A visitor **1306** can place a personal device into a mount, to quickly and easily have the Tawakkalna QR code read. In addition, a motor operated stand can adjust to the position of the visitor's forehead in order to accurately measure the visitor's body temperature. A QR code read and body temperature function **1712** reads, in S**1722**, and uses the QR code to determine whether the visitor's health information includes a vaccination for at least 2 doses and checks that the temperature degree is less than 38 degrees Celsius. A security guard **1304** can monitor the smart gate system **600** through a portal **1702**. In an embodiment, the portal **1702** is a Web interface that is provided on a terminal computer. The portal **1702** can include a visitor's data registration function **1714**, a smart gate operation function **1716**, and an emergency condition function **1718**.

[0123] With the visitor's data registration function **1714**, in S**1726**, the security guard **1304** can view and verify the visitor's health status in portal **1702**. In a case that the QR code read and body temperature function **1712** determines, in S**1730**, that the visitor's health information and the body temperature do not meet the required criteria, the visitor's data registration function **1714** will, in S**1732**, display in portal **1702** an indication that the visitor does not meet the required health criteria. In S**1734**, the data for an invalid visitor will be saved and maintained for reporting purposes in a database **606**, **1006**. The data for a valid visitor, including a data and time of verification, will be, in S**1726**, will be displayed in the portal **1714**, and, in S**1728**, recorded and maintained in a database **606**, **1006**. In S**1736**, a message will be sent by the operate smart gate function **1716** to open the gate and permit the visitor to enter.

[0124] In S**1738**, a visitor **1306** may press a button, or provide a gesture, or voice command, to

send an emergency request to open the gate, which will be handled by the emergency condition function **1718**. In S**1740**, the emergency condition function **1718** will provide an indication to the portal **1702** that an emergency opening request is being made. In S**1742**, the security guard **1304** can manually check the temperature of the visitor or manually check both the temperature and QR code of the visitor. The security guard **1304** can send a command to the smart gate operation function **1716** to open the gate, or to deny entry of the visitor **1306**. In S**1744**, the smart gate operation function **1716** will open the gate and send a message to the visitor **1306** that the visitor can proceed passed the gate. Otherwise, in S**1746**, the smart gate operation function **1716** will send a message to the visitor **1306** indicating that entry is denied, and a reason for the denial of entry.

[0125] FIG. **18** is a sequence diagram for a case of verifying health identify of a security guard. A security guard **1304** can access the smart gate system **600** through a portal **1802**. In an embodiment, the portal **1802** is a Web interface that is provided on a terminal computer. The portal **1802** can include a security guard registration function **1812**, a sign-in function **1814**, a password function **1816**, an edit profile function **1818**.

[0126] In the security guard registration function **1812**, in S**1802**, the security guard **1304** may begin by entering a registration request. In S**1804**, the smart gate system may check if the security person is already registered in the database **606**, **1006**. If the security person **1304** is already registered, in S**1806**, a message will be sent to the security guard portal. In S**1808**, the security guard **1304** may sign in. If the security guard is not registered, in S**1810**, the security person **1304** may receive a message indicating that security personnel data has not been stored in the database. In S**1812**, the security person may use the security guard registration function **1812** to send a request for registration to an admin user **1312**. The admin user **1312** can decide whether to approve registration of the security person **1304**. In S**1814**, if the security person **1304** receives a message that registration is approved, the security person **1304** may be provided with a form to submit registration information.

[0127] In the sign in function **1814**, in S**1816**, the security person **1304** can enter and/or create a username and password, and will receive a success message when the sign in is successful.

[0128] In S**1818**, in the case that the security person **1304** receives a message that registration is denied by the admin user **1312**, no further action can be made with regard to the smart gate system by the security person **1304**. A password function **1816** may be used by the security guard **1304** to, in S**1822**, change a password. The database **606**, **1006** may, in S**1824**, store the changed password, and, in S**1826**, send a message indicating that the password change is successful. In S**1828**, the sign in function **1814** may be used to sign in with the new password.

[0129] An edit profile function **1818** may, in S**1830**, be used by the security guard **1304** to edit the profile of the security guard. In S**1832**, the edit profile function **1818** may save the profile information in the database **606**, **1006**, and, in S**1834**, send a message indicating that changes have been successfully made to the profile and stored in the database **606**, **1006**.

[0130] FIG. **19** is a sequence diagram for a case of verifying health identity. The smart gate system **600** includes a QR code reader **708**, as a connected tool, a thermometer **706**, a timer **710**, and a sensor **712**. Data is transferred to a personal device **608** in the form of a QR code and, in S**1902**, the QR code reader **708** extracts the health status of the user that is encoded in the QR code. The personal device **608** is connected to an external database server **606**. The connection to the external database server **606** is managed by the operating system of the personal device **608**, which may be a mobile phone or other portable display device. In S**1904**, the thermometer **706** measures the visitor's body temperature and, in S**1906**, the smart gate system **600** verifies the health conditions of the visitor are satisfied and that the temperature of a visitor **1306** does not reach 38 degrees Celsius or more. The smart gate system **600** can include an emergency button **630**. In the case of the occurrence of an emergency or other problem, a visitor **1306** can press the emergency button **630** to call or request a security person.

[0131] The smart gate system **600** includes a gate operation mechanism **622**. The gate operation

mechanism **622** includes a motor unit for opening and closing a gate **620**, a controller for controlling the motor, a motion sensor **712**, such as an infrared sensor or laser, for determining whether a visitor **1306** is passing the gate **620** boundary, and a timer mechanism **710**. In S**1908**, in the case that the health conditions of the visitor are satisfied and the temperature is with acceptable range, the smart gate will open the gate. In S**1910**, the gate operating mechanism **622** may close the gate **620** based on the timer mechanism **710**. In an example embodiment, the closing process depends on timing by the timer mechanism **710** that, in S**1918**, times out in 3 seconds, followed by, in S**1914**, a sensor **712** that checks the passage of the visitor **1306** pass the opened gate **620**. In S**1920**, if the visitor **1306** does not pass the opened gate within the 3 seconds, the timer restarts. In S**1922**, the gate **620** is closed three seconds after the visitor **1306** has passed the gate **620**. A purpose of the timing mechanism **712** is to control flow of visitors through the smart gate in order to optimize the flow, as well as to prevent another visitor(s) from passing through the smart gate without being verified. The time out setting of the timing mechanism **710** may be adjustable and may be set at a different time out period.

[0132] FIG. **20** is a block diagram of general components of a microcontroller. The computer-based control system **702** may be implemented as a microcontroller. A microcontroller **2010** may contain one or more processor cores (CPUs **2001**) along with memory (volatile and non-volatile) and programmable input/output peripherals. Program memory in the form of flash **2003**, ROM, EPROM, or EEPROM **2005** is often included on chip, as well as a secondary RAM **2007** for data storage. In one embodiment, the computer-based system **702** is an Arduino integrated circuit board **702** with a microcontroller **2010**. The board includes digital I/O pins **2015**, analog inputs **2017**, hardware serial ports **2013**, a USB connection **2011**, a power jack **2019**, and a reset button **2021**. Although the Arduino is a widely used microcontroller-based board, it should be understood that other microcontroller configurations are possible. Variations can include the number of pins, whether or not the board includes communication ports or a reset button.

[0133] The microcontroller **2010** is a RISC-based microcontroller having flash memory **2003**, SRAM **2007**, EEPROM **2005**, general purpose I/O lines, general purpose registers, a real time counter, flexible timer/counters, an A/D converter **2009**, and a JTAG interface for on-chip debugging. The microcontroller **2010** is a single SOC. Although the description is of a particular microcontroller product, it should be understood that other microcontrollers may be used. Microcontrollers vary based on the number of processing cores, size of non-volatile memory, the size of data memory, as well as whether or not it includes an A/D converter or D/A converter.

[0134] Numerous modifications and variations are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

[0135] Thus, the foregoing discussion discloses and describes merely exemplary embodiments of the present invention. As will be understood by those skilled in the art, the present invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. Accordingly, the disclosure of the present invention is intended to be illustrative, but not limiting of the scope of the invention, as well as other claims. The disclosure, including any readily discernible variants of the teachings herein, defines, in part, the scope of the foregoing claim terminology such that no inventive subject matter is dedicated to the public.

[0136] In the above description, any processes, descriptions or blocks in flowcharts should be understood as representing modules, segments or portions of code which include one or more executable instructions for implementing specific logical functions or steps in the process, and alternate implementations are included within the scope of the exemplary embodiments of the present advancements in which functions can be executed out of order from that shown or discussed, including substantially concurrently or in reverse order, depending upon the functionality involved, as would be understood by those skilled in the art.

[0137] While certain embodiments have been described, these embodiments have been presented

by way of example only, and are not intended to limit the scope of the present disclosures. Indeed, the novel methods, apparatuses and systems described herein can be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the methods, apparatuses and systems described herein can be made without departing from the spirit of the present disclosures. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the present disclosure. For example, this technology may be structured for cloud computing whereby a single function is shared and processed in collaboration among a plurality of apparatuses via a network.

Claims

1-10. (canceled)

11. A smart gate system for vehicles, comprising: at least one terminal having a thermometer and a QR code reader; a server for receiving a reading from the thermometer, and health status information and date range from the QR code reader, and determining authorization to enter through a gate based on the thermometer reading, the health status information, and the date range, and sending an confirmation signal indicating authorization to enter, or denying entry; a microcontroller for opening a gate based on the confirmation signal and based on an operation signal from a security terminal to allow a single vehicle to pass through the opened gate; and a timer to time a predetermined duration that the gate remains open.

12. The smart gate system for vehicles of claim 11, wherein the timer includes a display component for displaying a countdown signal indicating remaining time until the gate will be reclosed.

13. The smart gate system for vehicles of claim 11, further comprising an object sensor, wherein the object sensor senses that a single vehicle has passed through the gate, wherein when the single vehicle is determined as passed the gate, the microcontroller closes the gate at a predetermined time measured by the timer.

14. The smart gate system for vehicles of claim 11, wherein the gate is a door and the microcontroller transmits control signals to open and close the door.

15. The smart gate system for vehicles of claim 11, wherein the QR code reader reads a health status QR code and records a current date when the health status information is read, wherein the server compares the date range to the current date, wherein when the current date is after date range, the server sends a control signal indicating that the entry is denied.

16-20. (canceled)