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(54) REMOTELY CONTROLLABLE AND CONFIGURABLE VEHICLE SECURITY SYSTEM

(76) Inventors: **Szuchao Huang**, Redwood Shores, CA (US); **Runghuang Tsai**, San Mateo, CA (US)

Correspondence Address:
CAPSTONE LAW GROUP LLP
1810 GATEWAY DRIVE
SUITE 260
SAN MATEO, CA 94404 (US)

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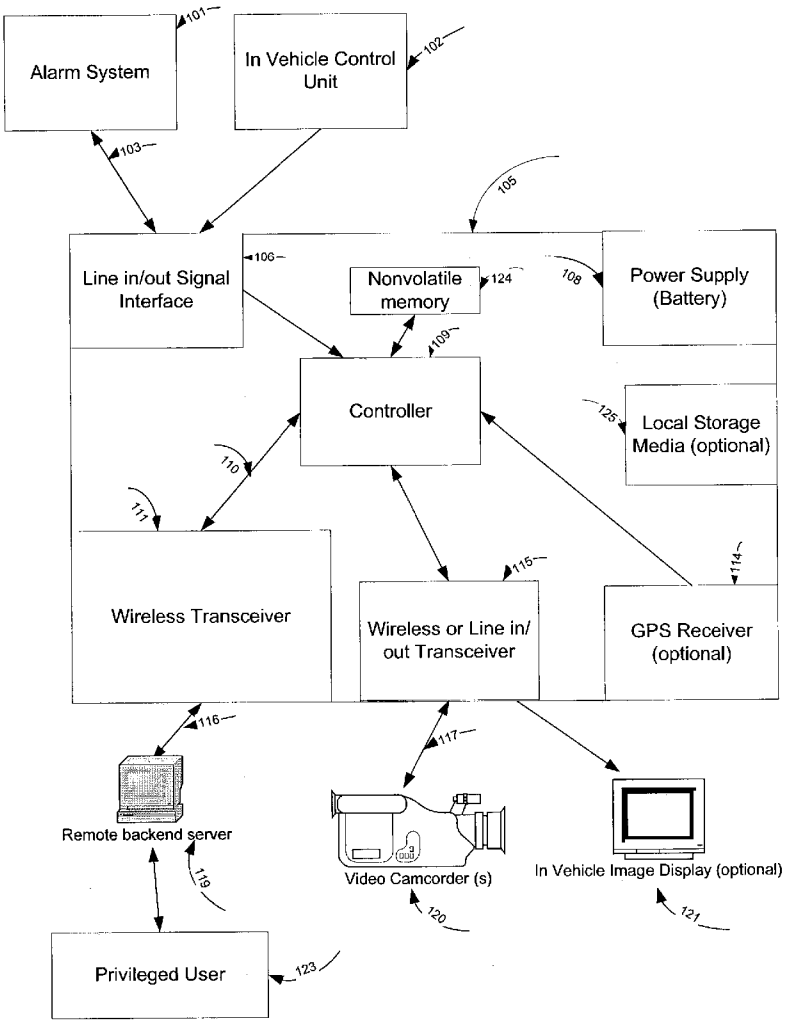
(57) **ABSTRACT**

A security control system for responding to security events detected by in-vehicle security systems utilizing vehicle-mounted video cameras. The system includes an in-vehicle control apparatus located within each vehicle that has a security system communications interface connected to the in-vehicle security system, memory, a controller configured to control operation of the video cameras in response to security events detected by the vehicle security system based upon configuration data and situation data, a wireless transceiver configured for bi-directional communication on a wireless link, and a communication link to the video cameras configured to transmit command data to the video cameras from the controller and receive captured images from the video cameras. Additionally, the system has a remote server in communication with the in-vehicle control apparatus of the plurality of vehicles via the wireless link, and a remote programming device in communication with the remote server via a communications network.



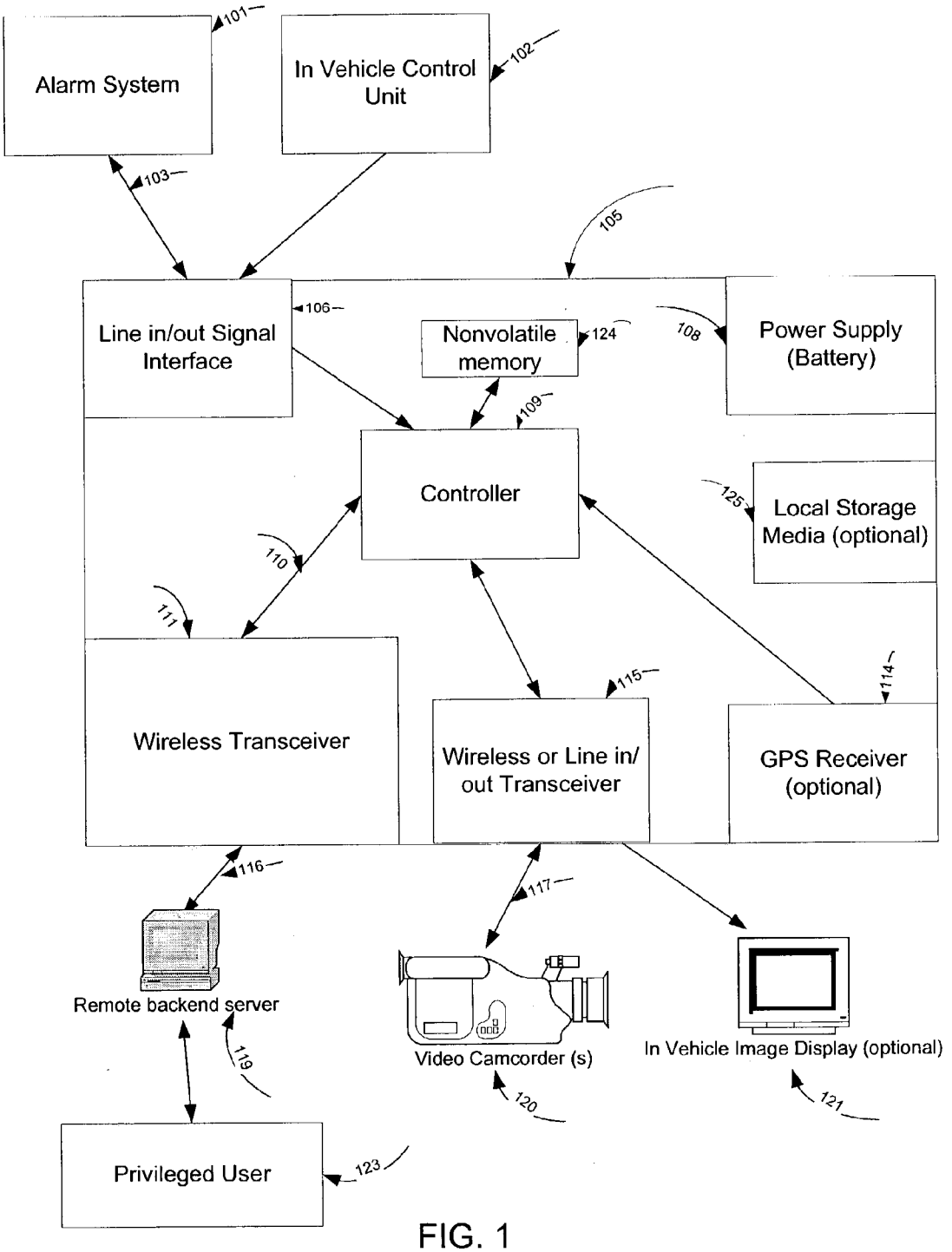

Alarm System
101
In Vehicle Control Unit
102
103
105
Line in/out Signal Interface
106
Nonvolatile memory
124
108
Power Supply (Battery)
109
Controller
125
Local Storage Media (optional)
110
111
Wireless Transceiver
115
Wireless or Line in/ out Transceiver
114
GPS Receiver (optional)
116
117
Remote backend server
119
Video Camcorder (s)
In Vehicle Image Display (optional)
120
121
Privileged User
123

FIG. 1

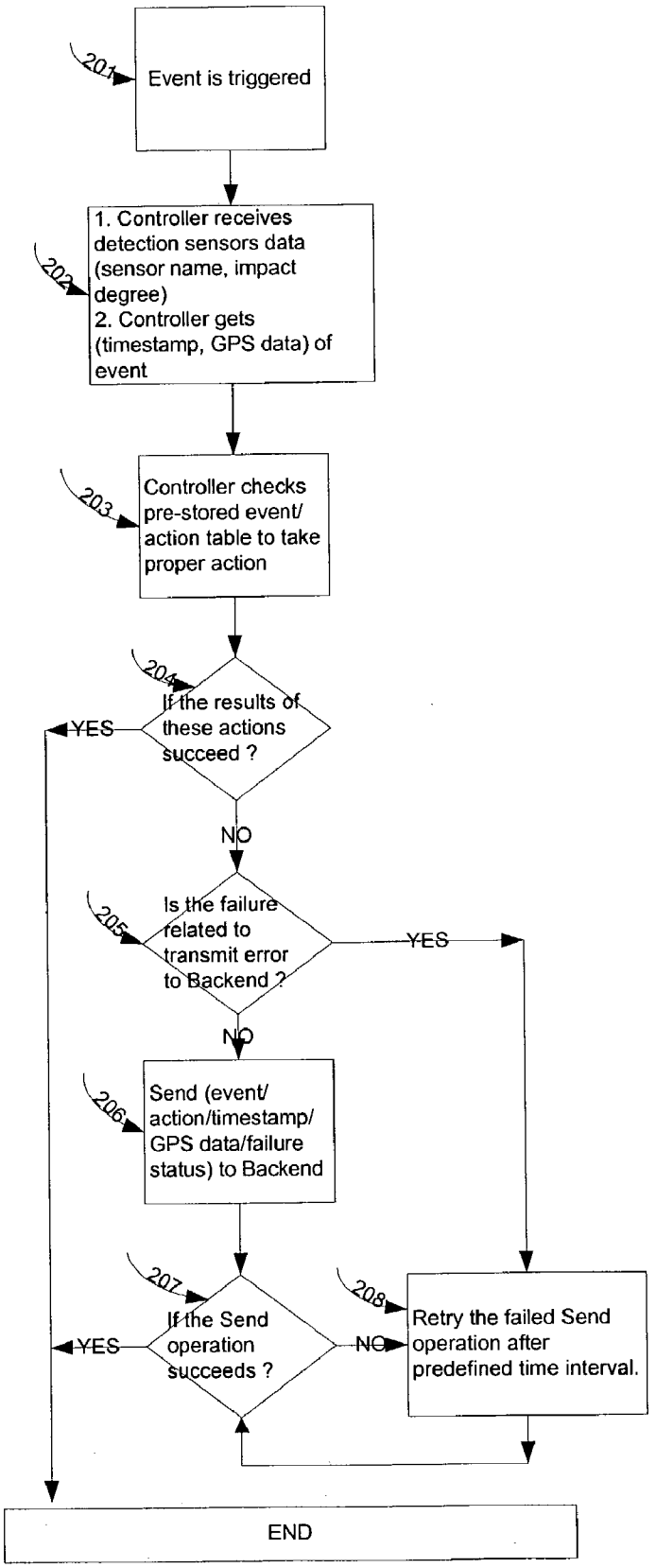

201
Event is triggered
202
1. Controller receives detection sensors data (sensor name, impact degree)
2. Controller gets (timestamp, GPS data) of event
203
Controller checks pre-stored event/ action table to take proper action
204
If the results of these actions succeed ?
YES
NO
205
Is the failure related to transmit error to Backend ?
YES
NO
206
Send (event/ action/timestamp/ GPS data/failure status) to Backend
207
If the Send operation succeeds ?
YES
NO
208
Retry the failed Send operation after predefined time interval.
END

FIG. 2

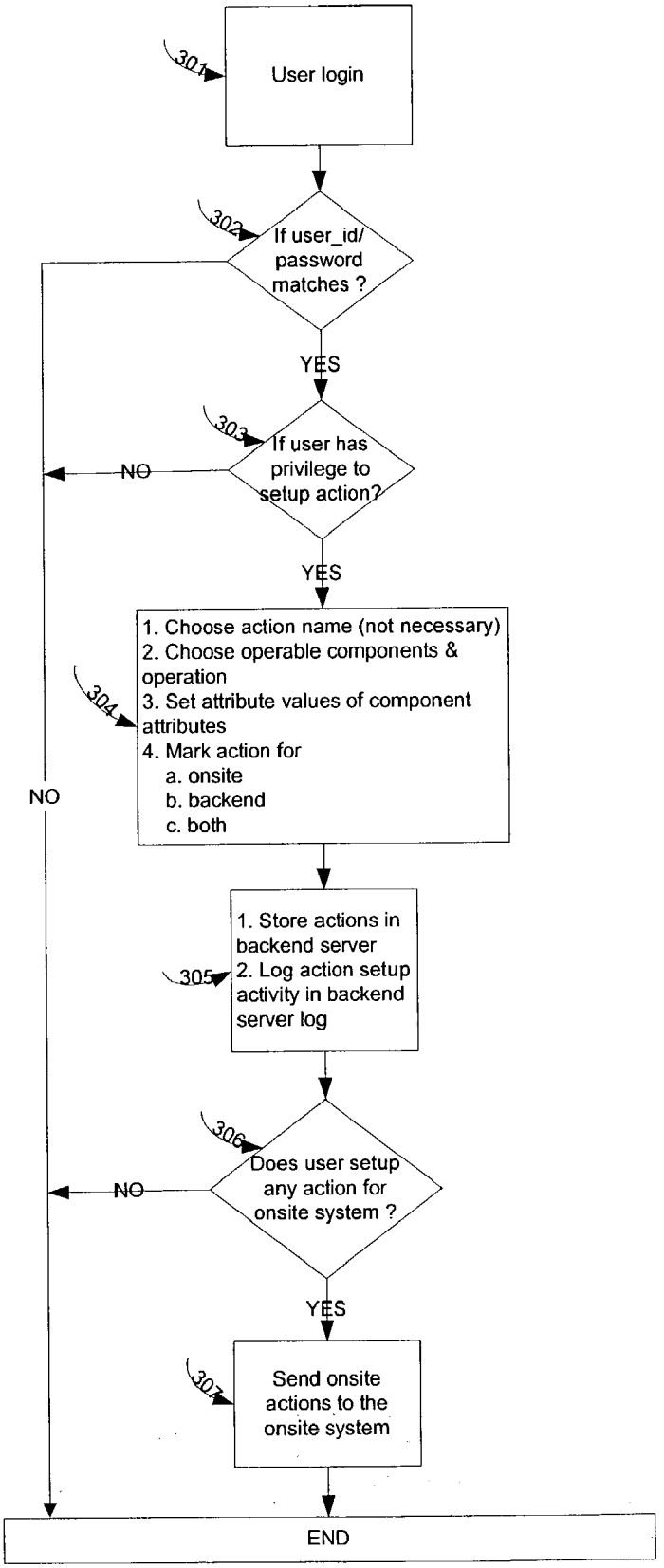

301
User login
302
If user_id/ password matches ?
YES
303
If user has privilege to setup action?
NO
YES
304
1. Choose action name (not necessary)
2. Choose operable components & operation
3. Set attribute values of component attributes
4. Mark action for
a. onsite
b. backend
c. both
NO
305
1. Store actions in backend server
2. Log action setup activity in backend server log
306
Does user setup any action for onsite system ?
NO
YES
307
Send onsite actions to the onsite system
END

FIG. 3

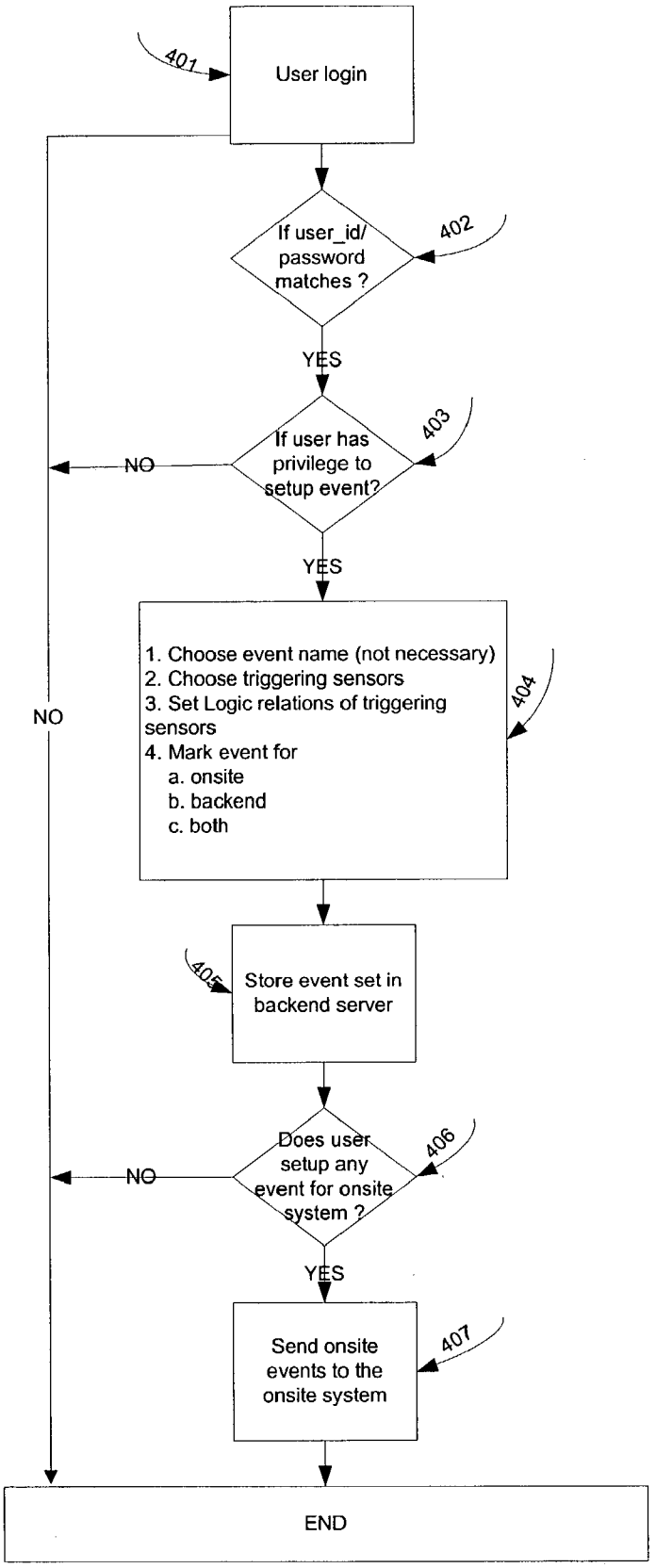

401
User login
If user_id/ password matches ?
402
YES
If user has privilege to setup event?
403
NO
YES
1. Choose event name (not necessary)
2. Choose triggering sensors
3. Set Logic relations of triggering sensors
4. Mark event for
a. onsite
b. backend
c. both
404
NO
405
Store event set in backend server
Does user setup any event for onsite system ?
406
NO
YES
Send onsite events to the onsite system
407
END

FIG. 4

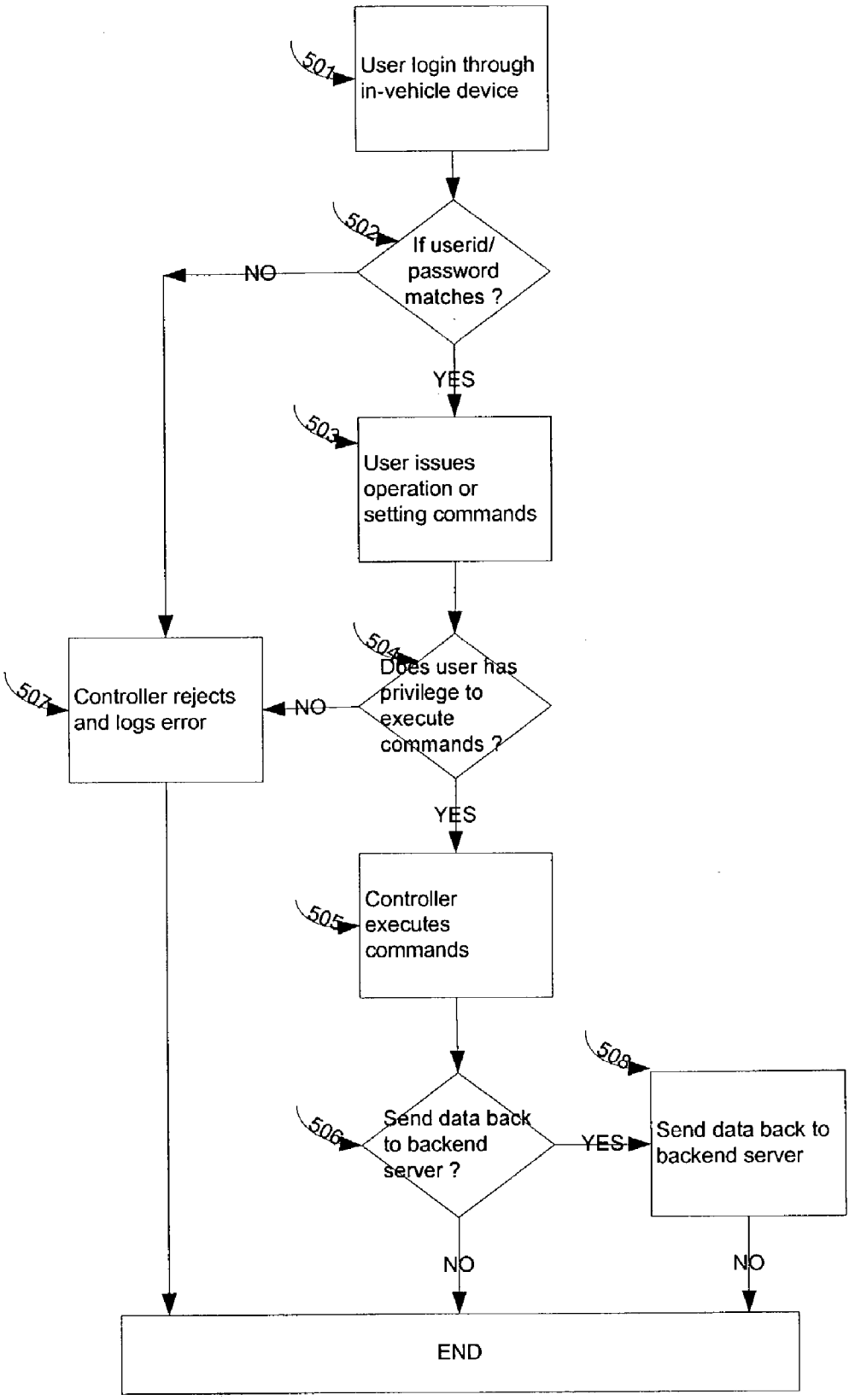

501
User login through in-vehicle device
502
If userid/ password matches ?
NO
YES
503
User issues operation or setting commands
504
Does user has privilege to execute commands ?
NO
507
Controller rejects and logs error
YES
505
Controller executes commands
506
Send data back to backend server ?
YES
508
Send data back to backend server
NO
NO
END

FIG. 5

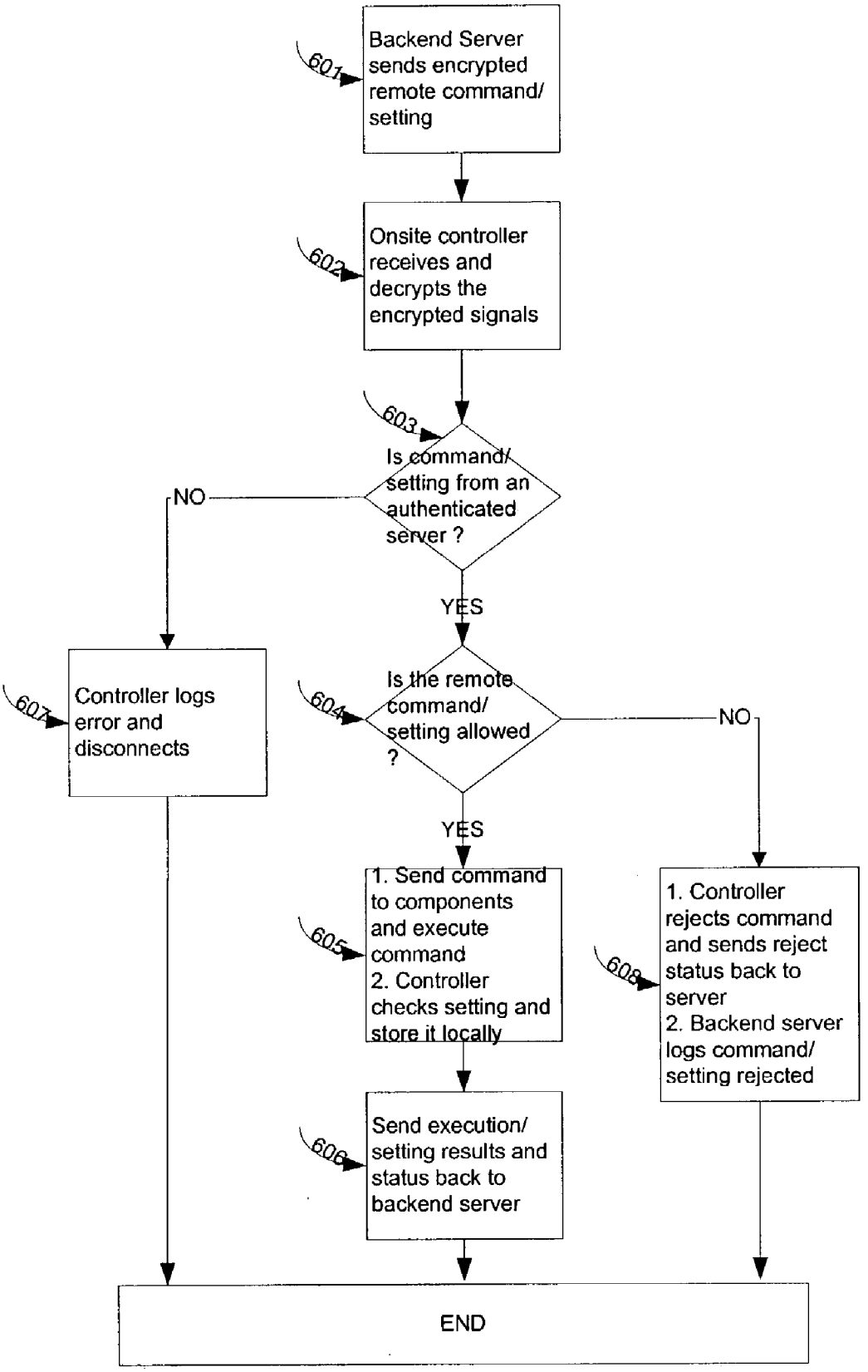

601
Backend Server sends encrypted remote command/ setting
602
Onsite controller receives and decrypts the encrypted signals
603
Is command/ setting from an authenticated server ?
NO
YES
607
Controller logs error and disconnects
604
Is the remote command/ setting allowed ?
NO
YES
605
1. Send command to components and execute command
2. Controller checks setting and store it locally
606
Send execution/ setting results and status back to backend server
608
1. Controller rejects command and sends reject status back to server
2. Backend server logs command/ setting rejected
END

FIG. 6

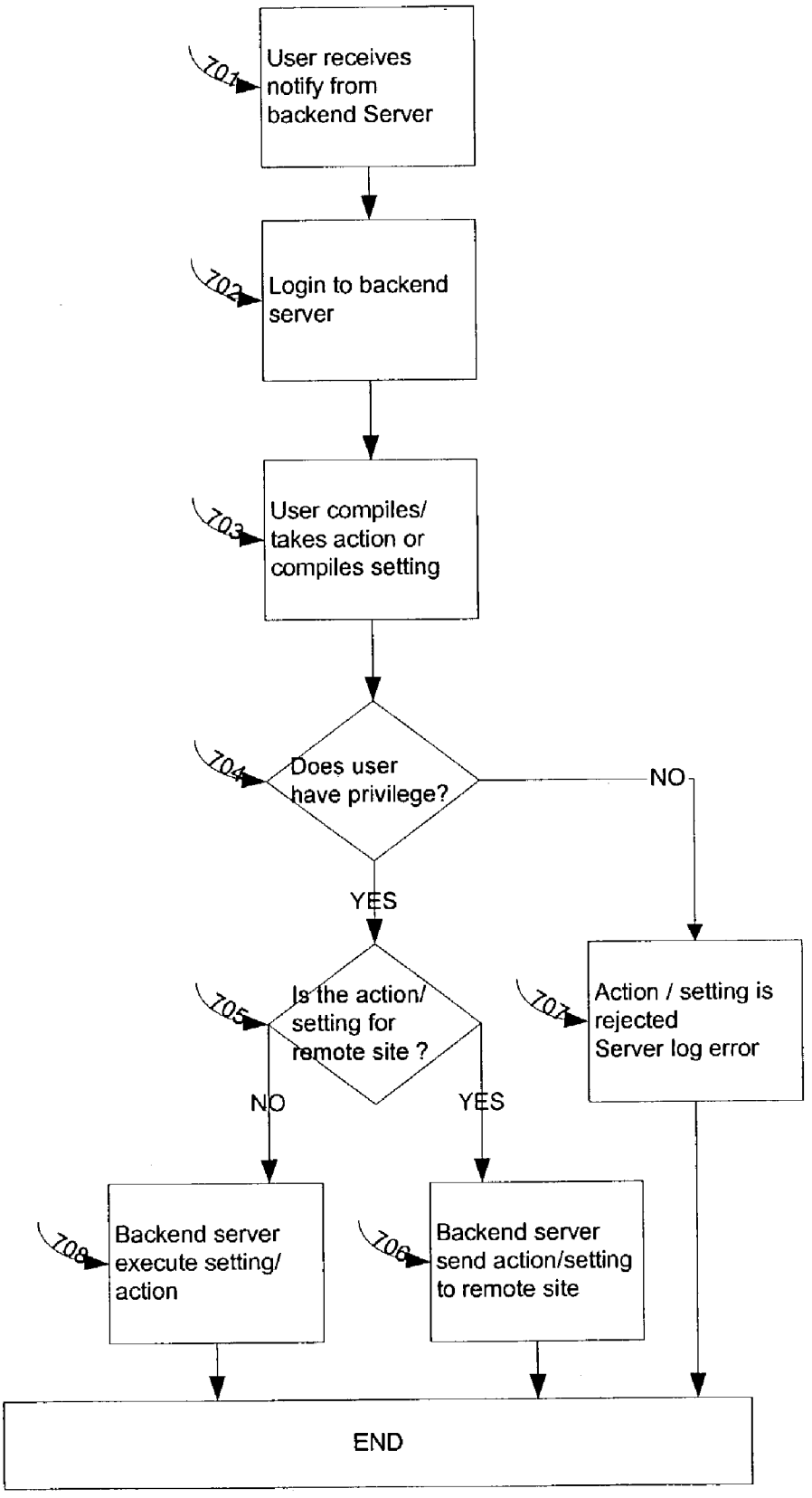

701
User receives notify from backend Server
702
Login to backend server
703
User compiles/ takes action or compiles setting
704
Does user have privilege?
NO
YES
705
Is the action/ setting for remote site ?
NO
YES
707
Action / setting is rejected Server log error
708
Backend server execute setting/ action
706
Backend server send action/setting to remote site
END

FIG. 7

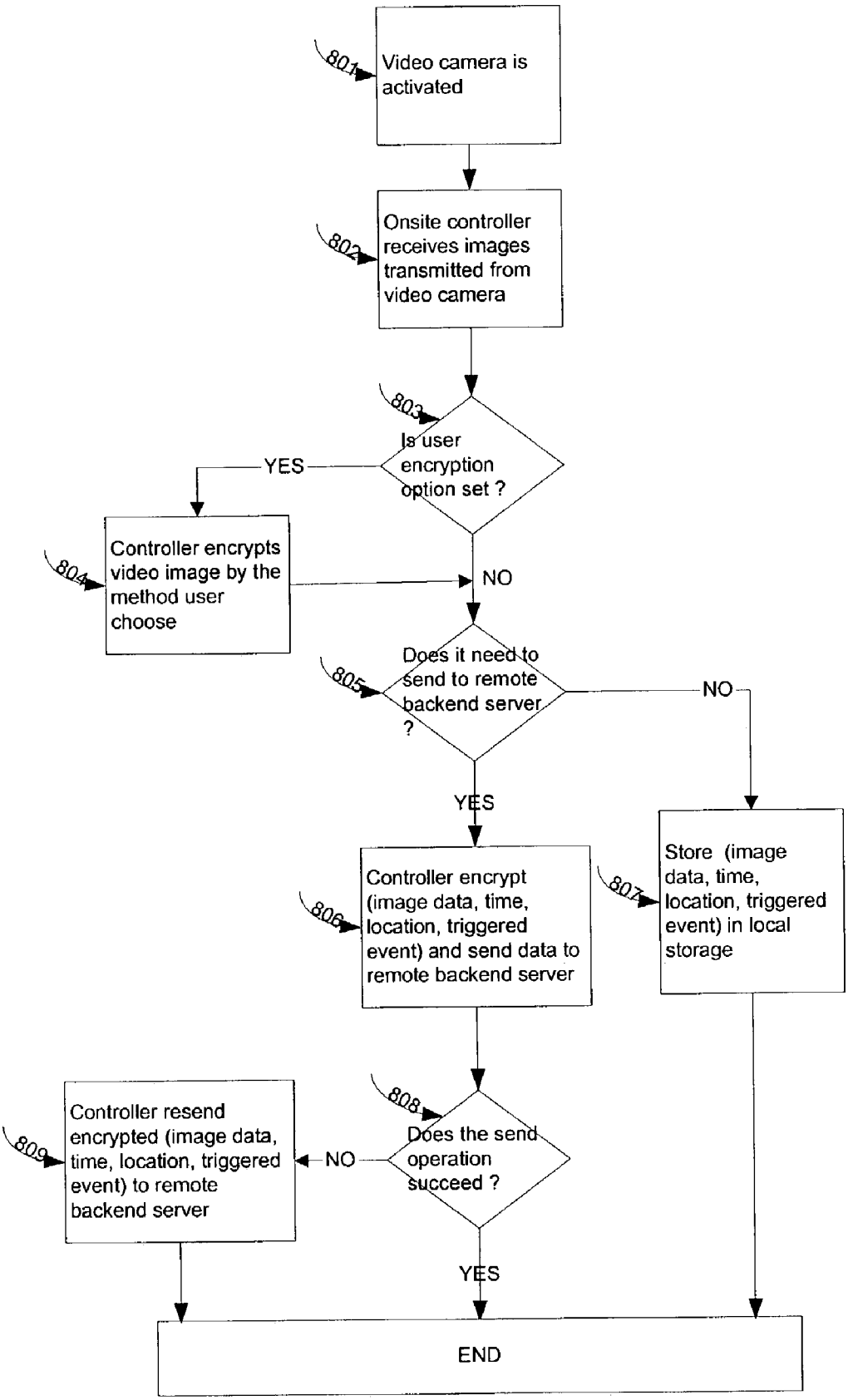

801
Video camera is activated
802
Onsite controller receives images transmitted from video camera
803
Is user encryption option set ?
YES
804
Controller encrypts video image by the method user choose
NO
805
Does it need to send to remote backend server ?
NO
YES
806
Controller encrypt (image data, time, location, triggered event) and send data to remote backend server
807
Store (image data, time, location, triggered event) in local storage
808
Does the send operation succeed ?
NO
809
Controller resend encrypted (image data, time, location, triggered event) to remote backend server
YES
END

FIG. 8

REMOTELY CONTROLLABLE AND CONFIGURABLE VEHICLE SECURITY SYSTEM

FIELD OF THE INVENTION

[0001] The present invention relates to a vehicle security system that is both remotely controllable and remotely configurable, and more particularly, a vehicle security system that is integrated with a user accessible backend server and intelligent in-vehicle controller.

BACKGROUND OF THE INVENTION

[0002] In recent years, vehicle theft and vandalism has become an increasing problem. To combat this problem, there are a wide variety of vehicle security systems available. These systems utilize motion detectors, glass breakage detectors, trunk and hood sensors, tilt sensors, power lock mechanisms, and other schemes to detect and deter thieves and vandals.

[0003] Also, more sophisticated systems are available to allow the monitoring of vehicle conditions by way of strategically located video camcorders and global positioning (GPS) tracking. Either unidirectional or bi-directional transmission channels allow for remote monitoring and response based upon conditions detected in and around the vehicle. Remote monitoring and response is effective in for both crime prevention and emergency event handling. However, current full feature systems require security personnel monitoring the images and other data received from the vehicle in real time, which is costly and impractical.

[0004] An example of such a security system is U.S. Pat. No. 5,027,104 to Reid, which discloses a vehicle security device, which includes multiple video camcorders that are activated responsive to certain conditions and are under the control of local controller mechanism. Captured video images are transmitted by the system to remote locations. However, there is no ability to control the vehicle security system from the remote locations based on the images or otherwise.

[0005] Other examples of vehicle security systems using video camcorders include the TaxiCam system by VerifEye Technologies of Ontario, Canada, and the Taxicab Security system by Sigtec of Melbourne, Australia. The images, gathered using limited view (i.e., fixed angle) video camcorders, are stored in control unit can be downloaded by cable to mobile data terminal unit or portable computer. Alternately, the systems can be configured with real time transmission of images via 2-way radio back to the control center. The systems provide for real-time video image capture and transfer to a remote location for monitoring purposes. However, there is no ability to control the vehicle security systems from the remote locations based on the images or otherwise. Moreover, costly human monitoring is required.

[0006] A system that provides control over the vehicle from a remote location based upon conditions sensed in the vehicle is U.S. Pat. No. 6,337,621 to Ogino et al. The system of Ogino coordinates between a vehicle-mounted security apparatus and an emergency response center. When a security breach or emergency condition is detected in the vehicle, the response center takes appropriate action. While this system allows for remote control over the in-vehicle security system, a costly human staffed response center is required. Additionally, there is no provision for remote configuration of the in-vehicle security system, direct user control, or video image capture.

[0007] A system that provides automated parallel and redundant subscriber contact and event notification is U.S. Pat. No. 6,442,241 to Tsumpes. The system enables automated simultaneous contact of one or more persons over a plurality of telephonic and electronic communication channels and provides parallel event-specific notification via voice, pager, fax, and email to the identified recipients(s) and a detailed message including the data and time of a specific event which has occurred with respect to a monitored sensor. The system can be triggered or programmed to perform its notification based upon the failure to receive an anticipated input and to operate at a specific time. However, there is no ability to take proper action(s) other than sending notifications. The system's main functionality is to notify the central monitoring station.

[0008] The systems described above provide a variety of in-vehicle security approaches but fail to provide a system that combines the time of event occurrence, vehicle location, and local geography information in order to process/respond to the event based on user configurable settings. In these systems, the actions taken in response to an event does not differ regardless of the time of the event, vehicle location, and local geography information.

[0009] In sum, these known methods and systems do not provide a flexible means for users to remotely interact with their vehicles in order to check the vehicle's surroundings, lock doors, dim lights, disable the ignition or the like. Moreover, most of these systems required remotely located personnel to monitor the in-vehicle security and emergency systems, which is costly. The present invention solves these problems.

SUMMARY OF THE INVENTION

[0010] The present invention is a security control system for responding to security events detected by in-vehicle security systems utilizing vehicle-mounted video cameras. The system includes an in-vehicle control apparatus located within each of the vehicles that has a security system communications interface connected to the in-vehicle security system, a data store configured to store configuration data, a controller connected to the security system communications interface and the data store and configured to control operation of the video cameras in response to security events detected by the vehicle security system based upon configuration data, a wireless transceiver configured for bi-directional communication on a wireless link, and a communication link to the video cameras configured to transmit command data to the video cameras from the controller and receive captured images from the video cameras. Additionally, the system has a remote server in communication with the in-vehicle control apparatus of the plurality of vehicles via the wireless link, and a remote programming device in communication with the remote server via a communications network. The configuration data input at the remote programming device is transmitted via the communications network to the remote server and from the remote server via the wireless link to the in-vehicle control apparatus for storage in the data store.

[0011] The present invention has other objects and advantages which are set forth in the description of the Best Mode of Carrying Out the Invention. The features and advantages described in the specification, however, are not all inclusive, and particularly, many additional features and advantages will be apparent to one of ordinary skill in the art in view of the drawings and specification herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] **FIG. 1** is a block diagram of the overall system components and configuration

[0013] **FIG. 2** is a flowchart depicting the in-vehicle controller handling process for in-vehicle events.

[0014] **FIG. 3** is a flowchart depicting the user action preference setup.

[0015] **FIG. 4** is a flowchart depicting the event parameter setup process.

[0016] **FIG. 5** is a flowchart depicting the user issued in-vehicle command process.

[0017] **FIG. 6** is a flowchart depicting the process of the backend server sending commands or settings to the in-vehicle control box.

[0018] **FIG. 7** is a flowchart depicting the process of the user notification and response process under control of the backend server.

[0019] **FIG. 8** is a flow chart depicting the process of the controller sending video images to the backend server.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Structure and Components

[0020] **FIG. 1** depicts a block diagram of an illustrative arrangement of the present invention including in-vehicle integrated components box **105**, which is coupled to alarm system **101**, in-vehicle user control unit **102**, vehicle mounted video camcorder(s) **120**, remote backend server **119**, remote user access device **123**, and an optional in-vehicle video image display **121**. Components box **105** includes line in signal interface **106** for receiving data signals from alarm system **101** and user control unit **102**, battery **108**, wireless transceiver **111** for bi-directional communications with backend server **119**, transceiver **115** for bi-directional communications with video camcorders **120**, and unidirectional transmission to in-vehicle display **121**. All of the various components in components box **105** are coupled to and operate under the control of controller **109**. Controller **109** is a standard commercial available microcontroller, such as a general-purpose microprocessor with a Linux or comparable OS. Controller **109** also includes a nonvolatile instruction memory **124** that holds a sequence of commands or steps that the controller follows.

[0021] Alarm system **101** can be any standard off the shelf vehicle alarm system for detecting motion, glass breakage, vehicle tilt, door opening, trunk opening, hood opening, and the like. In the event of an alarm being triggered, alarm system **101** emits an alarm signal on bi-directional communications line **103** that is received by line in signal interface **106**. The alarm signal (which may be as simple as a power on/off signal) contains data indicative of the particular triggering alarm event (e.g., broken glass or vehicle tilting). The format of the alarm signal is manufacturer dependent. In order to present the alarm data in a format useful to controller **109**, alarm signal interface **106** translates the alarm signal from the manufacturer specific format into a uniform format for processing by controller **109**. Likewise, any control signals from controller **109** to alarm system **101** are translated by alarm signal interface **106** into the manufacturer specific format. Alarm signal interface **106** is pre-programmed to interface with all required manufacturer specific formats.

[0022] Additionally, interface **106** serves to process signals from user control unit **102**, which is either a standard keypad or touch-screen device. User control unit **102** allows a privileged user to send commands to controller **109**. A privileged user is a person (typically the vehicle owner) in possession of the required authentication information (i.e., account name and password) to the remote backend server **119**. Each vehicle has its own distinct account name. The privileged user **123** can change the password.

[0023] As explained above, communication between alarm system **101** and controller **109** is bi-directional. This allows full control of alarm system **101**. For example, alarm system **101** may be switched on/off by control unit **102** or by off-site privileged user via control signals sent by controller **109** to alarm system **101**. Controller **109** sends the control signals based upon commands received from control unit **102** or by off-site privileged user.

[0024] Components box **105** is fully configurable by both in-vehicle control **102** and remote user device **123**. Configuration options include, for example, the frequency at which video camcorders **120** capture images, the time interval at which location information from GPS receiver **114** is gathered and provided to the user. Not all the signals from the alarm system **101** will trigger the video camcorders **120** and finally results the images send to the remote backend server **119**. A complete list of configuration options is described later in this specification. These configuration settings are stored in configuration tables within the non-volatile memory **124**, which map the event signals to the corresponding actions. Configuration tables may be updated by a privileged user **123** either locally using user control **102** or remotely via backend server **119**. Each input event signal has a default action set, the default may be ignore, take images and transmit to remote backend server **119**, emit panic sound, turn on head light to get attention, etc. The commands of the in-vehicle control unit **102** takes precedence over the commands of off-site privileged user in case of there is a command conflict. The in-vehicle control unit **102** can also be set to ignore any requests from the off-site privileged user. This is a security measure to prevent unauthorized access.

[0025] The vehicle-mounted video camcorder(s) **120** have either a multiply lens that can cover three hundreds and sixty degrees of view, or a rotating lens that can cover three hundreds and sixty degrees of view. Either of these lenses provides a full view and will not miss potentially important events, such as might occur with a partial view angle. The camcorder **120** should operate at reasonable dim light, preferably with infrared capability. The view area of the camcorder(s) **120** can be set by the user, therefore, either the

interior or exterior or both views can be captured. The camcorder(s) **120** can be disabled via user control **102** as desired. The optional in-vehicle video display **121** can display the vehicle-mounted video camcorder(s) **120** in real time to the user.

[**0026**] Wireless transmitter **111** exchanges encrypted data or signals **116**/**110** between the remote backend sever **119** and the controller **109**. Wireless or line-in transmitter **115** exchanges the data or signals **112**/**117** between vehicle-mounted video camcorder(s) **120** and the controller **109**. The optional GPS receiver **114** sends the geographical information to the controller **109** for every pre-defined time interval. If the vehicle is not in the driving mode and the controller **109** detects the changes of the geographical position, this implies the unauthorized moving the vehicle. The controller **109** now can apply the preset logic to take proper actions.

[**0027**] Optional local storage media **125** can be used to store the images. The media could be memory, tape, or hard disks. Not all the images taken by video camcorder(s) **120** must transmitted back to the remote backend server **119**, user may take images just for the scenery in the ad hoc mode and don't want to those images stored in the remote backend server **119**.

[**0028**] Remote backend server **119** may be any standard web server or web server cluster. Server **119** is able to communicate with multiple vehicles or to handle multiple users requests simultaneously. Additionally, server **119** stores user preferences and images captured by camcorders **120** along with the associated time stamp, optional GPS information and triggered event data. Privileged users **123** can login to the server **119** via phone, web browser, PDA or other communication devices to retrieve the images and change preference settings such as notification methods, mayday event handling (airbag deployment, user triggered panic button, etc.), alarm system **101** event handling.

[**0029**] The notification settings indicate to whom and how server **119** provides notifications. Privilege user **123** can select one or more preferred ways to receive the notifications such as email, phone, short message service and the like, and select one or more preferred parties to receive the notifications. Each event can have different notification settings (i.e., the notification is event driven). Remote backend server **119** may be configured as fully automated system without human intervention. For example, in the event of a vehicle accident, the images and location can be forward to the law enforcement's emergency response center.

[**0030**] In-vehicle component box **105** and server **119** are connected via a wireless network, such as the pager, cell phone, or satellite services networks. Remote user device **123** and server **119** are connected via the Internet using standard web access protocol such as HTTP. Remote user device **123** is any type of Internet enabled appliance, such as a Internet connected personal computer, PDA, cellular telephone, or the like.

[**0031**] If the in-vehicle component box **105** is further integrated with the electronic control system of the vehicle, the privileged user **123** might be able to lock/unlock the doors/windows, to disable the ignition or fueling system via the remote backend server **119**. This is particular useful in case the vehicle was stolen or hijacked. Another one is user accidentally leaves the key in the vehicle.

Operation

[**0032**] The system depicted in **FIG. 1** allows users to interact with their vehicles anywhere in the world via telephone, Internet, or other communication devices. Through backend server **119** and remote user equipment **123**, users are able to remotely monitor and control their vehicle's security system.

[**0033**] Based upon the preference settings, the set of local maps used for navigation system can be downloaded/updated from the backend server **119** and saved in the vehicle's attached local storage **125**. A new set of maps will be automatically downloaded in case of traveling close to the boundary of the existing map set. This "local intelligence" (i.e., local processing) eliminates the hassles of changing the CD/DVD maps periodically.

[**0034**] Remote backend server **119** can provide up-to-date information such as local traffic, weather, seasonal discount sales news, etc through a link to corresponding authorities. The information can then be transmitted to the vehicles based on the users'location.

[**0035**] The integration of alarm system **101** and remote backend server **119** provides for intelligent responses to alarm system **101**, for example, users are automatically notified when images are taken during a pre-configured event. The pre-configured events include discovering an unauthorized entry of the vehicle, airbag deployment, or the like. The appropriate law enforcement agency can also be notified depending on the preference settings in backend server **119**.

[**0036**] Users interact with the vehicles via backend server **119**. Authorized users send command to server **119**, which communicates with components box **105**, to take proper actions. The two-way communication signals between server **119** and components box **105** are encrypted

[**0037**] Images are stored and maintained in backend server **119**. This eliminates the need for components box **105** to store images in storage device **125**. The digital camcorders **120** are operable for both day and night. With optional GPS information, the system may alert a user when entering high crime rate area detected by controller **109** to activate the camcorders **120** to take images at defined time interval to ensure higher security. Another example is in the event of unauthorized towing of the vehicle, the user will be notified and able to see the image in real time. The user can also have an optional configuration to send the images not only to backend servers **119**, but also to an in-vehicle display to monitor the back seats. This usage is helpful for police officers when transmitting criminals, or for parents to monitor what their children are doing when seated in back.

[**0038**] Digital video camcorders **120** components box **105** to transmit the images wirelessly back to remote backend server **119** and to receive camcorder **120** control signals triggered by alarm system **101**, airbag deployment, and in-vehicle privileged users to take real-time images for further processing to remote backend server **119**. The system can also be operated by remote backend server **119** upon privileged user's request to remote control the vehicles such as taking real-time images, locking the car doors, etc. An optional GPS device can be integrated to the system to provide more information. The backend server **119** will notify privileged users or law enforcement when events

(alarm triggered, airbag deployment, and etc.) occur. The notified parties and event settings are configurable by privileged users through backend server **119**, which transmits the configuration data to controller **109** through wireless link **116**. The privileged users **123** can communicate with backend server **119** by phone, Internet, PDA, or other devices to control in-vehicle camcorder(s) **120** remotely.

[**0039**] Video images are encrypted and wirelessly transmitted (through RF or wireless phone network) to remote backend server **119** in real time. This real time wireless video image transmission capability prevents tampering with the images. Even if the system or vehicle itself is destroyed, the video will be safely stored in the remote backend server **119**. It also provides the users real time ability to access the video recorded anywhere in the world.

[**0040**] The system is fully integrated with alarm system **101** to prevent crime and vandalism. The signals of alarm system **101** are feed into the control unit of the system. If alarm system **101** is triggered, the signals are sent to the control unit. The unit uses a set of configurable predefined logics to choose the proper actions. The actions include but not limited to activating camcorders **120** to record events, sending images back to remote backend server **119** in real time, and notifying the vehicle owner.

[**0041**] The in-vehicle video camcorders **120** can be programmed to capture images when triggered by a Mayday signal or car accident event (such as a vehicle airbag deployed signal). Incorporation of the real time video images and GPS data improve Mayday support and speed up car accident rescue missions.

[**0042**] The system can be controlled by commands issued from remote backend server **119** through wireless transmitted signals. Backend server **119** can issue commands automatically based on internally stored logic. The commands issued by backend server **119** are encrypted during transmission and then are verified and decrypted by the in-vehicle control unit.

[**0043**] Video camcorders **120** can be triggered at the vehicle driver's will through local in-vehicle control unit **102**. The video camcorder **120** trigger events are programmable. The user can re-program the camcorder **120** settings from anyplace. The privilege commands are password protected; only privilege users have ability to reprogram the trigger events. The privilege users can even control the setting of video camcorders **120** to override the commands and requests issued by remote backend server **119** to protect user privacy. However the history of these override actions will be sent back and stored in remote backend server **119**.

[**0044**] Any video image that is sent back to remote backend server **119** or is stored in remote backend server **119** can be relayed to registered users immediately through different devices. The device could be phone, PDA, wireless phone or device with internet access capability but not limited to.

[**0045**] Privilege users can activate, reprogram or control the in-vehicle camcorders **120** and alarm security system remotely and in a real time manner by sending requests and commands to remote backend server **119** through Internet, wireless enabled PDA, email or phone. Backend server **119** will authenticate the users' requests then issue commands on behalf of the users to the in-vehicle camcorder **120** system and alarm system **101** via control box **105**.

[**0046**] The system can support from one or multiple video camcorders **120**. If multiple camcorders **120** are deployed, control box **105** can coordinate camcorders **120** to take video images of the are surrounding the vehicle. If only one video camcorder **120** is installed, a specialized camcorder **120**, which can take three hundred and sixty degree view video images of the surroundings, is used.

[**0047**] The trigger events are programmable from the remote backend server **119**. Thus, the logic, preference settings and features can be updated with ease at any time.

[**0048**] The system supports two-way communication between in-vehicle system, backend server **119** and remote users. All remote user requests and the complex logics are stored and processed in the powerful backend server **119**. As a result, in-vehicle controller **109** needs relatively little computing power and memory capacity to process and store simpler logics and configuration settings. This configuration provides an intelligent and flexible integrated system with high cost efficiency.

[**0049**] Control box **105** includes a GPS receiver **114**. Additionally control box **105** downloads crime rate data for particular locations from backend server **119** and stores the data in local storage **125** or in the nonvolatile memory of controller **109**. Thus, control box **105** may provide critical decision-making functions independent of backend server **119**.

[**0050**] Alternatively, control box **105** can send the GPS data back to remote backend server **119** when the driver parks the vehicle. If the server **119** decides the area has high crime rate by history statistics data, it could issue commands to reconfigure the settings of the system such as setting camcorders **120** to monitor surroundings of the vehicle periodically.

[**0051**] Events fall generally into five different categories:

[**0052**] 1. Sensor(s) in alarm system **101**.

[**0053**] 2. The pre-specified logic or condition stored in the nonvolatile memory **124** is satisfied.

[**0054**] 3. In-vehicle control unit **102**.

[**0055**] 4. Remote backend server **119**.

[**0056**] 5. In-vehicle integrated components control box **105**.

[**0057**] Control box **105** can receive any event triggered by categories 1, 2, 3, or 4. Backend server **119** can receive any event triggered by categories 1, 2, 3, 4, or 5. Each event is represented by the following attributes {Source name, Intensity, Time, Location, Extended data}.

[**0058**] Operable components can recieve and execute commands issued by controller **109**. The following are some examples of operable components:

Operable component	Operation
Power Door lock	Lock/Unlock/Set configure
Power Windows	Roll up/Roll down/Set configure

-continued

Operable component	Operation
Alarm Siren	Chirp/Full scale/Set configure
Horn	Honk/Set configure
Interior Light	Turn on/Turn off/Set configure
Ignition Starter	Turn on/Turn off/Set configure
Head Light	Turn on/Turn off/Set configure
Trunk	Lock/Unlock/Set configure
Digital Camcorder	Turn on/Turn off/Stand by/Take image/Set configure
GPS	Get location data/Set configure
Car Immobilizer	Arm/Disarm/Set configure

[0059] Each operable component has the following attributes stored in nonvolatile memory **124**: {Component name, Support operations, Current state, Last applied operation, Time of last applied operation, Remote command allowed, Extended data}.

[0060] Operation is a command sent to controller **109** to invoke an operable component. The operation comprises the following attributes:

[0061] {Target component name, Issuer, Operation, Frequency, Start time, End time, Intensity, Extended data}; however, not every attribute is required for different operations. For example:

[0062] Attributes for Door Lock Operation

Attribute Name	Attribute Value
Target component name	Front door on the driver side
Issuer	Controller
Operation	Lock
Frequency	N/A
Start time	Immediately
End time	N/A
Intensity	N/A
Extended data	N/A

[0063] Attributes of Camcorder **120** Operation

Attribute Name	Attribute Value
Target component name	Digital Camcorder
Issuer	Backend Server, Rung Tsai
Operation	Take image
Frequency	10 frames/sec
Start time	Apr. 20, 2003 12:03:20
End time	Apr. 20, 2003 12:45:30
Intensity	Strongest
Extended data	N/A

[0064] Attributes of Alarm Siren Operation

Attribute Name	Attribute Value
Target component name	Alarm siren
Issuer	Controller
Operation	Turn on

-continued

Attribute Name	Attribute Value
Frequency	N/A
Start time	Apr. 20, 2003 18:40:30
End time	Apr. 20, 2003 18:45:30
Intensity	Strongest
Extended data	N/A

[0065] When control box **105** processes detect abnormal conditions, it takes two additional factors, time and location, into consideration. Hence, the same type of events may not be dealt with the same way if the time and location of the event are different. For example, the event of the impact sensor detecting a medium impact hit on the vehicle. An event like this could be sent to controller **109** as: {Source name: Impact sensor, Intensity: medium, Time: Apr. 28, 2003 23:35:48, Location: GPS data, Extended data: N/A}. Controller **109** gets the crime rate of the location pre-stored in local storage **125**, and then evaluates the crime rate of this location and time of the event detected to decide the proper action. For this event, if the location has high crime rate and the time of the event happening is close to midnight, controller **109** activates camcorder **120** and sends the captured images to backend server **119**. Backend server **119** then notifies the user. The user can login to backend server **119** to watch the real time images and take the appropriate action. Time and location are used as the "contribution factors" to the vehicle security systems.

[0066] However if the same event happens but controller **109** determines the vehicle is in a very safe location, then the system will not disturb user for the event, which may be caused by neighbor's cat jumping on the vehicle.

[0067] The intelligent controller **109** can download the crime rate of the local area from the backend server **119** to local storage **125**. An exemplary event trigger condition is as follows: if the vehicle is moving in a high crime rate area then an event {Source name: Controller, Intensity: high, Time: current time, Location: GPS data, Extend data: N/A} will be issued by the controller **109**. Controller **109** determines the necessary action to be taken. The action could be that the controller **109** checks the vehicle condition and sends a warning to the driver. For example, when an event is triggered, controller **109** could warn the driver and roll up the windows automatically. Controller **109** automatically downloads the crime rate data periodically as the vehicle traveling in different areas.

[0068] Another usage is that parent can set the "out of area event" and get notified when their children drive out of a certain area. The area here is a region defined by the parent, i.e., privileged user. The area data is stored in both backend server **119** and in-vehicle memory (either nonvolatile memory **124** or local storage **125**). Controller **109** can check if the vehicle is in the area without contacting backend server **119** to reduce the frequency of communicating with backend server **119**.

[0069] A further integration with intelligent home technology is possible. For example, when the vehicle is close to home then backend server **119** can send preset commands to activate home appliances (i.e. air conditioner/light/garage door) if the intelligent home management software is integrated with backend server **119**.

[0070] When a predefined car accident event occurs, such as air bag deployed signal or user activated Mayday signal, event data is provided to controller **109**. Taking the air bag deployed event as an example, the following event attributes are sent to controller **109**: {Source name: Air bag deploy, Intensity: high, Time: current time, Location: GPS data, Extend data: N/A}. Controller **109** checks the event/action table and takes the corresponding action for the event. If the user does not redefine new action for the car accident event, then the default action will be taken: controller **109** activates video camcorders **120**, which immediately records video images continuously and transmits encrypted (video image data and the car accident event) back to remote server **119** in real time. When backend server **119** receives the car accident event, it checks the event/action table and takes the corresponding action for the event. The default action for the car accident event may include notifying the nearest emergency rescue team and providing the real time video images to them to indicate the needed equipment and trained medical staff, notifying local police, and notifying the emergency contact persons appointed by the user.

[0071] Upon receiving event notification, user can also receive real time images from backend server **119** on devices such as a PDA via secure network. The user can also login to backend server **119** to watch real time video images and send operations to the vehicle to respond to the event (see **FIG. 7**). Referring to the above example:

[0072] 1. The impact sensor detects medium impact in a high crime rate area and user receives notification from backend server **119** (Step **701**).

[0073] 2. User logs in to backend server **119** through Internet (Step **702**).

[0074] 3. User can take action to watch real time video image sent back from in-vehicle camcorder **120** (Step **703**).

[0075] 4. Backend server **119** checks if user has privilege to review the video image (Step **704**). If user does not have proper privilege to watch video image, then backend server **119** rejects the user's request and logs the rejected request (Step **707**). This watch operation is local to backend server **119**.

[0076] 5. Server executes the operation for the user (Step **708**). Or

[0077] 6. The user can also send operation commands to remotely control in-vehicle video camcorder **120**. After the user views the video image, he can turn off the siren if desired by recompiling the siren operation.

[0078] 7. Backend server **119** checks if the user has the privilege to execute the operation (Step **704**). If user does not have privilege, the request is rejected.

[0079] 8. Backend server **119** checks if the operation is for the remote system (Step **705**). Since the siren turn off operation is a remote operation, the server **119** encrypts and sends the operation to in-vehicle system to turn it off (Step **706**).

[0080] 9. Controller **109** receives and decrypts the encrypted signal from server **119** (Step **602**).

[0081] 10. Controller **109** checks if the signals are from an authenticated server **119** (Step **603**). If the signals are not from authenticated server **119** then the controller **109** logs "not authenticated server **119**" error and disconnects (Step **607**). If the controller **109** verifies the signals then the controller **109** checks if the siren accepts remote control (Step **604**).

[0082] 11. If the remote operation is allowed, then the controller **109** interprets the operation and sends proper signal to siren to turn off the alarm siren (Step **605**).

[0083] 12. After the siren is turn off, the controller **109** reports the result back to backend server **119** (Step **606**).

[0084] If the user does not receive the notification from backend server **119** in time, backend server **119** or controller **109** have the following logic: "if user does not respond within a certain time, then it can take preset action X". The action X will be taken by backend server **119** or by controller **109** to response to the situation without user intervention. When the user gets chance to login to server **119**, the user can check the real time image by controlling the in-vehicle camcorder **120** remotely. The user can issue the following operation command: {Target component name: Digital Camcorder, Issuer: "Backend Server, Rung Tsai", Operation: Take image, Frequency: 10 frames/sec, Start time: Apr. 29, 2003 01:35:48, End time: Apr. 29, 2003 01:45:00, Intensity: N/A, Extended data: "Encrypt: Public key, Storage: Backend Server"}. Backend server **119** encrypts the operation command and sends it to controller **109**. Controller **109** receives and decrypts the encrypted signal from server **119** (Step **602**). Controller **109** checks if the signals are from an authenticated server **119** (Step **603**). After controller **109** verifies that the signals do come from authenticated server **119**, controller **109** checks if camcorder **120** accepts remote control (Step **604**). If the remote operation is allowed, then controller **109** interprets the operation command and sends proper signal to operate camcorder **120** (Step **605**). After camcorder **120** is activated, the controller **109** receives real time images from camcorder **120** through wireless transmitter **115** (Step **802**). The controller **109** checks if the encrypt option is set in the operation command (Step **803**). The encrypt option is set to "public key" in the extended data field of the command. It tells controller **109** to use the public key encryption algorithm to encrypt the images (Step **804**). This provides privacy for the user. The images will be encrypted with the public key of the user. Only user who holds the private key is able to decrypt the images. Even backend server **119** is unable to decrypt user images. The communication between in-vehicle system and backend server **119** is always encrypted.

[0085] Controller **109** then checks if it needs send images to backend server **119** (Step **805**). The extended data attribute of the operation is set to "Storage: Backend Server". It directs controller **109** to send back images to backend server **119**. Controller **109** encrypts the triggered event and time and location data, and sends the encrypted data to backend server **119** (Step **806**). Since the images have been encrypted with the users public key, the controller **109** does not need to encrypt the images again.

[0086] It is a powerful capability to allow off-site user and backend server **119** control the in-vehicle system remotely.

However, this remote control ability raises great concern over user privacy. It is an important feature allowing the privileged user to set the in-vehicle system to reject the commands issued from remote backend server **119** or through in vehicle control unit **102**. This override request will be sent back to remote backend server **119** and logged in backend server **119**. For example, the privileged user can issue a command to set video camcorder **120** to reject the remote command issued by backend server **119** (Step **503**). The command is {Target component: Camcorder, Issuer: "In-vehicle control unit, Rung Tsai", Operation: Set configure, Frequency: N/A, Start time: N/A, End time: N/A, Intensity: N/A, Extended data: "Remote command allowed: No"}. Controller **109** checks if the user has privilege to issue the command (Step **504**). If the user has proper privilege the controller **109** executes the command to set camcorder component **120** to reject any remote operation (Step **505**). Controller **109** will send all of component setting change activities back to backend server **119** (Step **508**).

[**0087**] A hand-held device carried by the user may be employed to let in-vehicle digital camcorder **120** track the user. The purpose of this device is to let camcorder **120** know where to capture images. When a user parks his car he can carry the device. The device activates camcorder **120** and adjusts focus to follow the user home. The image taken can be sent back to remote server **119** immediately.

Server and In Vehicle Processes

[**0088**] **FIG. 2** is a flowchart depicting the process of how in-vehicle controller **109** handles triggered in-vehicle events. When alarm system **101** sensors detect an abnormal condition occurring in the vehicle, a pre-defined condition in controller **109** being satisfied or a user notification issued by in-vehicle control unit **102**, an event is triggered (step **201**). The signals go through the line in/out signal interface **106** and are sent to controller **109**. Controller **109** determines the attribute values of the triggered event such as names and impact degrees (intensity) of the abnormal-condition-detected sensors. At the same time, controller **109** gets timestamp and location data for the event from the controller's timer and GPS device **114** (step **202**). Controller **109** checks the predefined event-action table stored in nonvolatile memory to see if the event has a correspondent action. If there is a correspondent predefined action for the triggered event, controller **109** executes the action. Otherwise controller **109** executes the default action in response to the triggered event (Step **203**). To execute the action, controller **109** sends signals through line in/out signal interface **106** to involved components of alarm system **101** and through wireless in/out transmitter **115** to video camcorders **120** if camcorder **120** operation is involved. The action may require the transmission of status or image data to backend server **119**. Controller **109** sends signals via wireless transceiver **111** to remote backend server **119**. After the action is complete, controller **109** checks whether the action succeeds or fails (Step **204**). If any operation of the action fails, then controller **109** verifies whether the failure involve data transmission errors between control box **105** and backend server **119** (Step **205**). If the failure has nothing to do with data transmission then controller **109** sends the triggered event, the action taken and failed operations to backend server **119** (Step **206**). Controller **109** again checks if step **206** succeeds (Step **207**). If step **206** fails, then controller **109** executes a retry procedure (Step **208**). If the failure involves data transmission problems between remote backend server **119** and control box **105**, controller **109** will execute a retry procedure (Step **208**). In the retry procedure, controller **109** logs problems and retransmits data in a predefined time interval. After the retry, controller **109** checks if the retry succeeds (Step **207**).

[**0089**] **FIG. 3** is a flowchart depicting the user preference setup process for control box **105** and backend server **119**. A user logs in to remote backend server **119** (Step **301**). Backend server **119** checks if the user name and password are correct (Step **302**). If the user name and password are not correct, the backend server **119** rejects the user login. If the user name and password are correct, server **119** checks the user privilege to see if the user has the proper privilege to setup actions (Step **303**). If the user does not have the proper privilege, then the request is rejected. If the user has privilege to setup actions, then the user is allowed to start the process for action setup (Step **304**). In the action setup process, the first step is that user can choose the name of the action he is setting up to uniquely identify the action. However it is not necessary for the user to name every action he creates. If the name of the action is not specified then backend server **119** creates a unique action name for the user automatically. The second step is that the user decides what operations the action is composed of. The action can be a single operation or a set of operations. Then the user must decide if the action is for control box **105**, backend server **119**, or both. Once the user completes the action setup, backend server **119** validates the actions and stores them in backend server **119**. Backend server **119** also logs the action setup activity of the user in backend server **119** log (Step **305**). Backend server **119** checks if there is any action for control box **105** (Step **306**). If all the actions are for backend server **119**, then user completes the action setup process. If there is any action for control box **105**, then backend server **119** encrypts and sends these actions data to control box **105** and updates controller **109** (Step **307**).

[**0090**] **FIG. 4** is a flowchart depicting the event parameter setup process for control box **105** and backend server **119**. A user logs in to remote backend server **119** (Step **401**). The backend server **119** checks if the user name and password are correct (Step **402**). If the user name and password are not correct, backend server **119** rejects the login. If the user name and password are correct, server **119** checks the user privilege to see if the user has the proper privilege to setup event (Step **403**). If the user does not have the proper privilege then request is rejected. If the login user has privilege then user can start the process for event set setup (Step **404**). In the process of the event set setup, the first step is that user can choose the unique name of the event set (Step **404.1**). It is not necessary for user to name every event set user creates. If the name of event set is not specified then the backend server **119** can create a unique event set name for user automatically. The next step is to choose the sensor(s) corresponding to the event set (Step **404.2**). An event set can relate to one or multiple sensors, user can set the logical relation (i.e. AND, OR) among the participated sensor(s) in the event set (Step **404.3**). For example, an event set maybe defined as "1. Sensor A is on, or 2. Sensor B and sensor C are both on". Then the user chooses if the action is for control box **105**, backend server **119**, or even both (Step **404.4**). Backend server **119** validates the event set and stores it in backend server **119** (Step **405**). Backend server **119** checks if there is any event set for the in-vehicle system

(Step **406**). If all the actions are for backend server **119**, then the user completes the action setup process. If there is any action for control box **105**, then backend server **119** encrypts and sends the actions data to control box **105** and updates controller **109** (Step **407**).

[**0091**] **FIG. 5** is a flowchart depicting the process of the user issuing an in-vehicle command. Users enter login name and password though in-vehicle control device **102** (Step **501**). Controller **109** checks if the user name and password match (Step **502**). If the password is not correct then the controller **109** rejects the login request and logs the errors (Step **507**). If the login name and password of the user are correct, then the user is permitted to issue commands to operate components or change local settings (Step **503**). The commands are sent to controller **109** through Line in/out signal interface **106**. Controller **109** checks if the user has the privilege to issue the command (Step **504**). If the user does not have proper privilege to issue the command, then controller **109** rejects the commands and logs the error (Step **507**). If the user has proper privilege for the command, then controller **109** will execute the command (Step **505**). Controller **109** checks if the issued commands need to send data to backend server **119** (Step **506**). If it is necessary to send data to backend server **119**, controller **109** encrypts and sends the data to backend server **119** (Step **508**).

[**0092**] **FIG. 6** is a flowchart depicting the process of the backend server **119** sending commands or settings to control box **105**. Backend server **119** encrypts the commands or settings, and then sends the data to control box **105** (Step **601**). Controller **109** receives signals from wireless transceiver **111**. Controller **109** then decrypts the encrypted signals (Step **602**). Then, controller **109** checks if the data was sent by an authenticated remote server **119** (Step **603**). If the data is not from an authenticated source, then controller **109** rejects the data and disconnects the connection. Controller **109** logs the error and informs remote backend server **119** of the unauthenticated connection attempt (Step **607**). If the connection is coming from an authenticated source, then controller **109** checks if the remote command or setting is allowed (Step **604**). If the remote command or setting option is set to disable, then controller **109** rejects the commands or setting requests issued from backend server **119** and informs server **119** the reason for the rejection. Remote backend server **119** receives the rejection from controller **109** and logs the event (Step **608**). If remote commands and settings are allowed, for commands controller **109** checks the targeted component if the operation is legal. If the remote commands are allowed, then controller **109** sends operation commands to the target component for execution (Step **605.1**). For settings, controller **109** stores them in nonvolatile memory **124** or local storage **125** after controller **109** validates the settings (Step **605.2**).

[**0093**] **FIG. 7** is a flowchart depicting the process of the user notification and response process under control of backend server **119**. When the user receives a notification from backend server **119** (Step **701**), the user may decide to take actions such as watching the video images taken by the system, sending operation commands to control box **105** or changing the settings of control box **105**. The user receiving the notification can login to backend server **119** by phone or through Internet (Step **702**). After backend server **119** verifies the login name and password of the user, the user can take actions to respond to the notification. The actions could be watching video images sent from camcorder **120**, changing settings of backend server **119** or control box **105**, or any combination of those. The user can compile the actions he wants to take for the event (Step **703**). Backend server **119** will verify if the user has proper privilege for executing these actions (Step **704**). Backend server **119** will reject the actions and log the rejected actions for the record if the user does not have privilege for these actions (Step **707**). If the user has privilege for the actions, server **119** will check if there is any action or setting for control box **105** (Step **705**). If all of the actions issued by the user are for backend server **119** only, then backend server **119** executes these actions (Step **708**). If there are actions or settings for control box **105**, then backend server **119** will send these user actions or settings to control box **105** on behalf of the user (Step **706**).

[**0094**] **FIG. 8** is a flow chart depicting the process of the controller **109** sending video images to backend server **119**. Video camcorder **120** receives operation commands issued by controller **109** on behalf of remote backend server **119**, controller **109** itself, or the user using control unit **102** in the vehicle (Step **801**). Video camcorder **120** is operating and sending image data through wireless line in/out transceiver **115** to controller **109** (Step **802**). The controller **109** first checks if the encryption option is set by the user (Step **803**). If the user encrypt option is on, then controller **109** encrypts the image data using the pre-specified encryption algorithm (Step **804**). Otherwise, controller **109** will not encrypt image data at this moment. Controller **109** checks if the image data needs to be sent back to remote backend server **119** (Step **805**). If video camcorder component **120** is set to not remotely store data, then the image data will be stored in local storage **125** (Step **807**). If the image data needs to be sent to backend server **119**, controller **109** encrypts the image data and triggered event data, and sends the encrypted data to backend server **119** (Step **806**). The communication between controller **109** and backend server **119** is always encrypted. But for the better privacy protection, the user can even set the parameters to encrypt the image data using a special encryption algorithm such as public key/private key protection, so that only the user can watch the image. In this form, backend server **119** cannot access the user's image data.

[**0095**] From the above description, it will be apparent that the invention disclosed herein provides a novel and advantageous vehicle security system that is both remotely controllable and remotely configurable. The foregoing discussion discloses and describes merely exemplary methods and embodiments of the present invention. One skilled in the art will readily recognize from such discussion that various changes, modifications and variations may be made therein without departing from the spirit and scope of the invention.

We claim:

1. A security control system for responding to security events detected by in-vehicle security systems located within a plurality of vehicles having vehicle-mounted video cameras comprising:

an in-vehicle control apparatus located within each of the vehicles comprising:

a security system communications interface connected to the in-vehicle security system;

a data store configured to store configuration data;

a controller connected to the security system communications interface and the memory and configured to control operation of the video cameras in response to security events detected by the vehicle security system based upon configuration data and situation data;

a wireless transceiver configured for bi-directional communication on a wireless link;

a communication link to the video cameras configured to transmit command data to the video cameras from the controller and receive captured images from the video cameras;

a remote server in communication with the in-vehicle control apparatus of the plurality of vehicles via the wireless link; and

a remote programming device in communication with the remote server via a communications network, the remote programming device being configured for the input of the configuration data;

wherein the configuration data input at the remote programming device is transmitted via the communications network to the remote server and from the remote server via the wireless link to the in-vehicle control apparatus for storage in the data store.

2. The system recited in claim 1, wherein the captured images are transmitted to remote server via the wireless communications link.

3. The system recited in claim 1, further comprising a data entry device located within the vehicle and coupled to the in-vehicle control apparatus and configured for the input of the configuration data.

4. The system recited in claim 1, wherein the remote server is configured to authenticate the remote programming device through a secure login procedure.

5. The system recited in claim 1, wherein the situation data includes vehicle location data, local geography data and time of day data.

6. The system recited in claim 5, wherein the vehicle location data is provided by a global positioning system.

7. The system recited in claim 1, wherein in response to detection of a security event by the in-vehicle security system, the in-vehicle control apparatus transmits event data comprising data indicative of the security event, a time stamp, and the captured images to the remote server.

8. The system recited in claim 1, wherein in response to detection of a security event by the in-vehicle security system, the in-vehicle control apparatus is configured to transmit data indicative of the security event to the remote server, and wherein the remote server is configured to compare the security event data to a set of pre-defined response criteria and based upon the comparison to provide a notification of the security event to the remote programming device.

9. A remotely configurable in-vehicle control apparatus for responding to security events detected by an in-vehicle security system located within a vehicle having vehicle-mounted video cameras and for communicating with a remote server via a wireless link and a remote programming device configured for input of configuration data and coupled to the remote server via a communications network comprising:

a security system communications interface connected to the in-vehicle security system;

a data store configured to store configuration data;

a controller connected to the security system communications interface and the data store and configured to control operation of the video cameras in response to security events detected by the vehicle security system based upon configuration data;

a wireless transceiver configured for bi-directional communication on the wireless link;

a communication link to the video cameras configured to transmit command data to the video cameras from the controller and receive captured images from the video cameras;

wherein the configuration data input at the remote programming device is transmitted via the communications network to the remote server and from the remote server via the wireless link to the in-vehicle control apparatus for storage in the data store.

10. The apparatus recited in claim 9, wherein the captured images are transmitted to remote server via the wireless communications link.

11. The apparatus recited in claim 9, wherein the situation data includes vehicle location data, local geography data and time of day data.

12. The apparatus recited in claim 11, wherein the vehicle location data is provided by a global positioning system.

13. The apparatus recited in claim 9, wherein in response to detection of a security event by the in-vehicle security system, the in-vehicle control apparatus transmits event data comprising data indicative of the security event, a time stamp, and the captured images to the remote server.

14. The apparatus recited in claim 9, wherein in response to detection of a security event by the in-vehicle security system, the in-vehicle control apparatus is configured to transmit data indicative of the security event to the remote server, and wherein the remote server is configured to compare the security event data to a set of pre-defined response criteria and based upon the comparison to provide a notification of the security event to the remote programming device.

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