APPARATUS, SYSTEM AND METHOD FOR MANAGING A VEHICLE PARK

FIELD OF THE INVENTION

The invention relates to an apparatus, system and method for managing a vehicle park or any other premise that requires monitoring, watching, recording, scanning or surveillance.

BACKGROUND TO THE INVENTION

The following discussion of the background to the invention is intended to facilitate an understanding of the present invention. However, it should be appreciated that the discussion is not an acknowledgment or admission that any of the material referred to was published, known or part of the common general knowledge in any jurisdiction as at the priority date of the application.

A vehicle park (or known as parking lot) is a cleared area that is intended for parking vehicles. In countries where vehicle (e.g., car, motorcycle, automobile, truck, bus) is the dominant mode of transportation, vehicle parks are a feature of every city and suburban area. Due to the increasing prevalence of vehicle usage in many countries, vehicle parks today are often large in size with numerous small and narrow slots, and are crowded during peak hours with vehicles moving in and out. These trends require active and intelligent management of vehicle parks in particularly as to, for example, vehicle damage, pedestrian injury and vehicle collision/prang/crash in vehicle parks as well as parking fee collection and vehicle entrance/exit management.

In fact, parking a vehicle inside a vehicle park is not as safe as one would like to expect. A significant number of vehicle collisions/prangs/crashes/scratches occurs in vehicle parks, particularly when a vehicle moves in to (or out of) a specific parking slot/lane. Cameras capturing snapshot images of a parking

slot/lane at a predetermined interval of time might help capture some useful information of an event (e.g., vehicle-vehicle, vehicle-pedestrian collision/prang/crash; vehicle scratch), but in general fail to capture the event in its entirety as the predetermined time interval is often quite long. For instance, the beginning or the end of an event of interest might fall within the predetermined time interval and is accordingly not captured by the snapshots. The lack of complete information leaves room for disputes, and could negatively affect the relevant parties in getting proper compensation or insurance claim. Setting cameras across a large vehicle park to capture images at a high frame per second (FPS) is not feasible due to the huge amount of data generated and the difficulties in image/video content analysis. Thus, there exists a technical need to devise a system and method to utilize the cameras in such a way that only images related to events of interest are captured, and the images captured can reflect the events of interest in their entirety.

Another important aspect of vehicle park management is with regards to the collection of parking fees, which is in general conducted at the entrance/exit of a vehicle park. Thus, cameras installed at the entrance/exit of the vehicle parks should also be arranged in such a way that only events of interests (e.g., vehicle tailgating; parking fee payment evasion) are captured, and those events are captured in their entirety. Specifically, vehicle parks for allowing vehicles to be parked can be a source of revenue and income for the owners or managers of such vehicle parks or parking lots, which can range from an open air plot of tarmac or concrete to multi-storied parking lots. Typical methods of collecting revenue use a paper ticket, either to be displayed upon parking or collected by the vehicle upon entering the vehicle park while more updated versions can involve payment electronically either through electronic banking or linked to credit/debit card accounts. The easier and most efficient method of controlling a vehicle park would be via the entrance and exits as this allows the overall system to be automated. How it works is a vehicle would stop at the entrance and the time of entry is noted and tagged to a vehicle, either by issuing a ticket to the vehicle, scanning the vehicle license plate number, or electronically capturing the

vehicle's In-Vehicle Unit (IU) number. Then upon exit, the vehicle owner would present the ticket at the exit and pay; or have the vehicle license plate scanned, recalled and present payment, or have the IU number captured recalled and deduct payment (through the cashcard in the IU). The system that captures the IU number has been found to be fast, efficient and effective and examples of this type has been deployed in several malls in Singapore.

For the vehicle park entrance and exit, a gantry is employed to allow vehicles through one at a time and these gantries form a movable barrier that moves aside to allow a vehicle through. Because of safety purposes and due to the varying lengths of vehicles, sensors are employed to determine when a vehicle has passed before allowing the gantry to move back into position, however due to the time needed to move the gantry back into position, i.e. the safety margin, a vehicle can bypass the gantry by tailgating another vehicle in front, thus causing the system to detect either one long vehicle, or that a first vehicle had passed but due to the sensor causing a safety override, the gantry could not move back into position before a second vehicle passed through. This would typically occur at the exit, especially when unscrupulous motorists try to exit the vehicle park without payment. This would evident at the end of the day when the system records show that a particular vehicle entered the vehicle park but did not exit, even though the vehicle park is empty. Some system are able to flag an error message (e.g., an electronic message that carries an incomplete IU transaction label that has information as to the entry time and the parking slot/lane of the vehicle, but does not have its exit information) indicating a possible tailgating incident, however, because of the safety override, these vehicles are allowed to escape payment.

Other types of gantry errors include the gantry suffering a mechanical failure or being knocked down, which results in vehicles exiting the vehicle park without payment or capture of the vehicle details. The automation of present day vehicle parks exacerbates the situation since the control centre controlling and managing the vehicle park may not be on-site, and thus would not be able to respond

promptly to the situation, leading to a loss of revenue as vehicles exit without payment. Another situation that may occur is when the cashcard within the IU has insufficient funds to pay the parking fees, especially when there is a queue of vehicles waiting to exit, making it virtually impossible for the vehicle to turn around to top up the cashcard before exiting again. In such instances, to ease the traffic jam, the gantry may be raised via a manual override, either remotely or onsite, and the vehicle is allowed to exit without payment.

With the prevalence of video cameras security, the conventional solution would be to review the entire day's security footage in order to record down the vehicle's details. This may require a manual screening of more than a thousand vehicles in order to determine the details of the offending vehicle. However, even if the vehicle is located, follow up action may not be forthcoming since the vehicle may not visit the vehicle park soon. And even if the vehicle were to visit the vehicle park again, some systems may lack the storage or processing power to recognise that the vehicle entering has defaulted to on a previous parking payment before and flag the vehicle accordingly.

There exists a need to be able to manage vehicle parking lots efficiently, quickly, automatically and also remotely, to at least alleviate one or more of the above mentioned problems.

SUMMARY OF THE INVENTION

Throughout this document, unless otherwise indicated to the contrary, the terms "comprising", "consisting of", and the like, are to be construed as non-exhaustive, or in other words, as meaning "including, but not limited to".

Throughout the specification, unless the context requires otherwise, the word "comprise" or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

Throughout the specification, unless the context requires otherwise, the word "include" or variations such as "includes" or "including", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

Throughout the description, the term 'file' and its plural form refer to electronic data files capable of being stored in non-transitory computer readable media such as servers, processors, databases, memory blocks, space, segments etc.

Throughout the description, the term "video" refers to an electronic data file that comprises a plurality of images and optionally audio.

Furthermore, throughout the description, the term "electronic instruction" refers to a portion of programming code that is sent from a source to an apparatus, device or equipment over one or more communication channels, the electronic instruction operable to prompt an apparatus, device or equipment to execute a function. The "electronic instruction" can be a segment of code that contains steps that need to be executed by the apparatus, device or equipment that receive the segment of code. In this regard, the electronic instruction can also function as an electronic trigger.

The system is especially suited, but not limited to monitoring and recording vehicle movement inside a premise such as a vehicle park. Embodiments of the invention will be described in such context.

It is an object of the present invention to provide a new system and method for managing a vehicle park or any other premise that requires monitoring, watching, recording, scanning or surveillance.

Improvements in the art are made by system in accordance with the present invention. A first advantage of the system in accordance with this invention is that it is able to manage a premise, such as a vehicle park, remotely and efficiently. This lowers manpower requirement. A second advantage of the system in accordance with this invention is that it is able to provide video evidence of users

who evade payment either maliciously or because of a system error. This ensures that revenue due could be traced to the errant users of the vehicle park. A third advantage of the system in accordance with this invention is that operators are able to quickly review an error report in the system together with the video evidence. This is due to ability of the system to save evidence associated with an event in an event file, such evidence in the form of a plurality of images or video captured before, during and after the event. The event file may further be tagged with identification information and one or more error reports may be generated based on one or more event files, and presenting the error report in a clear and coherent way.

In accordance with an aspect of the invention there is a system for managing a vehicle park comprising a server, a video recorder, a video camera, and a gantry system, whereby when an event of interest occurs, the video recorder is able to save footage of the event. Preferably, the footage of the event is saved in an event file that is tagged with appropriate identification information. Preferably, the event file is tagged with identification information relating to the event. The identification information could be the date, the time, the location, and the type of error. Preferably, the system can generate a report that collates one or more event files with some particular information tag(s), such as time period, location and type of error. Preferably, the event of interest is vehicle tailgating at the gantry system of a vehicle park. Preferably, a sensor is implemented with the gantry system that enables the detection of tailgating vehicles.

In accordance with another aspect of the invention, there is a system for event detection at a premise comprising: an image capturing device operable to capture at least one image of the premise at every predetermined time interval; a memory device comprising a buffer memory arranged in data communication with the image capturing device, the memory device for receiving the at least one image captured by the image capturing device; a server arranged in data communication with the memory device; a gantry system arranged in data communication with the server, wherein the server, upon receipt of an error

message from the gantry system triggered by an event, sends an electronic instruction to the memory device to store in the buffer memory an event file comprising at least an image before the event, an image at the time the event occurs and an image after the event. The present system mitigates the existing technical problems on using image capturing devices (e.g., cameras) for managing the entry and exit of vehicles at a vehicle park. First of all, as the information captured by the present invention (i.e., event file) includes the scenes (e.g., images or videos) before, during and after the entry/exit of vehicles at the gantries of the vehicle park, the event files can be particular useful in serious circumstances (e.g., the evasion of paying the vehicle parking fees) that require complete, reliable and convincing evidences. Also, as only images or videos related to events of interest (e.g., tailgating, barrier malfunctioning) are stored, the data storage required for implementing the present invention is much smaller and more manageable. Preferably, the event file is not directly sent to the back-end server for storage, but instead, employs a memory device comprising a buffer memory as an intermediary storage to store the images and videos. This arrangement of the present invention functions to alleviate the possible data traffic congestion between the image capturing devices and the backend server. For instance, during the peak hours when there are many vehicles moving in and out at the entrance/exit gantries of the vehicle parks, the image capturing devices installed at the entrance(s)/exit(s) of the vehicle parks are all operating actively. If the images captured are directly sent to the backend server for storage, the backend server might collapse due to data traffic congestion in the network that connects server and the memory devices. The present invention can effectively mitigate such collapse and improve the reliability of the system by utilizing a memory device as a buffer storage and reducing the data traffic towards the backend server during the peak hours.

Preferably, the image capturing device is a video camera. A video camera is particularly suited for electronic motion picture acquisition, and can produce a clear and coherent video stream of the event of interest.

Preferably, the memory device is a video recorder. A video recorder is particularly suited for storing video data (e.g., MOV, MP4, WMV, AVI, webm, flv, f4v).

Preferably, the event file is a video file. A video file is particular suited for displaying an event of interest in a clear and coherent manner.

Preferably, the premise is a vehicle park. Vehicle parks require active monitoring and surveillance. Vehicle parks today are ubiquitously installed with image capturing devices, which provide the necessary infrastructure and hardware for implementing the present system.

Preferably, the gantry system is equipped with at least one sensor. A sensor is particularly suited for detecting an event of interest (e.g., vehicle tailgating, mechanical failure of barrier, barrier being knocked down, barrier arm hanging due to power trip).

Preferably, the at least one sensor is a safety sensor that prevents a barrier arm of the gantry system from falling on a vehicle. Such a safety sensor is particularly suited for triggering a safety override to prevent a movable barrier arm from falling onto a passing vehicle when, for example, a vehicle tries to bypass the gantry system by tailgating another vehicle in front. Using a safety sensor would improve the sensitivity and accuracy of the system in detecting an event of interest (e.g., vehicle tailgating).

Preferably, the safety sensor is a photodetector sensor, a laser sensor or a magnetic sensor. Such advanced sensors are able to improve the sensitivity and accuracy of the system in detecting an event of interest (e.g., vehicle tailgating).

Preferably, the sensor projects a sensor curtain that can differentiate that there are a plurality of vehicles passing through the gantry within a fixed period of time. Such a sensor curtain can further improve the sensitivity and accuracy of the system in detecting an event of interest (e.g., vehicle tailgating, mechanical

failure of barrier, barrier being knocked down, barrier arm hanging due to power trip).

Preferably, the sensor is positioned to detect if only one vehicle passes through the gantry at a time. This arrangement further improves the sensitivity and accuracy of the system in detecting an event of interest (e.g., vehicle tailgating, mechanical failure of barrier, barrier being knocked down, barrier arm hanging due to power trip).

Preferably, the event file is tagged with at least one identification information. The tagging of identification information can facilitate, for example, the search through the event files for a particular incident, the preparation of a report that collates the events, and accordingly reduce the need of manpower in analysing the event files.

Preferably, the identification information is selected from the group comprising vehicle plate number, vehicle IU number, vehicle colour, vehicle model, exit lane number, entrance lane number, gantry number, date, time, premise name, premise address, vehicle park name and vehicle park address. Such identification information is particular suited for facilitating, for example, the search through the event files for a particular incident and the preparation of a report that collates events.

Preferably, the event file is transmitted by the memory device to the server for long-term storage. The long-term storage of the event files in the server can alleviate the need to employ memory device (comprising buffer memory) with large data storage capacity, and at the same time, facilitate the inspection of the event files in the long run.

Preferably, the server is operable to generate a report based on the event file. Such a function of the server facilitates the inspection of the event files and eases the burden of time-and-effort in finding a specific event file as well as analysing a group of event files together to understand the management of the premise.

Preferably, the error message is triggered when a barrier arm of the gantry system is not in a predetermined the position. Such an error message improves the sensitivity and accuracy of the system in detecting an event of interest (e.g., vehicle tailgating, mechanical failure of barrier, barrier being knocked down, barrier arm hanging due to power trip).

Preferably, the buffer memory is a storage medium selected from the group comprising random-access memory (RAM), a hard disk, a flash memory, a compact flash (CF) card, a secure digital (SD) card, a smart media (SM) card, a multimedia card (MMC) and a memory stick. These storage medium are particularly suited for temporarily storing the event files.

In accordance with another aspect of the invention, there is provided a system for event detection at a premise comprising: an image capturing device operable to capture at least one image of the premise at every predetermined time interval; a memory device comprising a buffer memory arranged in data communication with the image capturing device, the memory device for receiving the at least one image captured by the image capturing device; an event detection module operable to detect an event and send an electronic instruction to the memory device to store in the buffer memory an event file comprising at least an image before the event, an image at the time the event occurs and an image after the event. The present system mitigates the existing technical problems on using cameras for managing vehicle parking. First of all, as the information captured by the present invention (i.e., event file) includes the scenes (e.g., images or videos) before the event, at the time the event occurs as well as after the event, the event file can provide a complete picture of the event from the beginning to the end. Such event files can be particularly useful in serious circumstances (e.g., vehicle accident disputes; insurance claim on vehicle damage) that require complete, reliable and convincing evidences. Also, as only images or videos related to events of interest are stored, the data storage required for implementing the present invention is much smaller and more manageable. Furthermore, in the present system, the event file is not directly sent to the back-

end server for storage, but instead, employs a memory device comprising a buffer memory as an intermediary storage to store the images and videos. This arrangement of the present invention functions to alleviate the possible data traffic congestion between the image capturing devices and the backend server. For instance, during the peak hours when there are many vehicles moving in and out of the vehicle parks, the image capturing devices installed across the vehicle park are all operating actively. If the images captured are directly sent to the backend server for storage, the backend server might collapse due to the data traffic congestion in the network. The present invention can effectively mitigate such collapse and improve the reliability of the system by utilizing a memory device as a buffer storage and reducing the data traffic towards the backend server during the peak hours.

Preferably, the image capturing device is a video camera. A video camera is particularly suited for electronic motion picture acquisition, and can produce a clear and coherent video stream of the event of interest.

Preferably, the memory device is a video recorder. A video recorder is particularly suited for storing video data (e.g., MOV, MP4, WMV, AVI, webm, flv, f4v).

Preferably, the event file is a video. A video file is particular suited for displaying an event of interest in a clear and coherent manner.

Preferably, the premise is a vehicle park. Vehicle parks require active monitoring and surveillance. Vehicle parks today are ubiquitously installed with image capturing devices which provide the necessary infrastructure and hardware for implementing the present system.

Preferably, the event is a vehicle moving into or out of a parking slot. A significant number of vehicle-vehicle, vehicle-pedestrian collisions/prangs/crashes/scratches occur when a vehicle moves into or out of a particular parking slot/lane that is becoming increasingly small and narrow in today's vehicle parks. Defining the event to be a vehicle moving into or out of a

parking slot/lane facilitates the management of the vehicle park by, for example, collecting evidences as to incidents occurred at the vehicle parking slots/lanes.

Preferably, the event is a vehicle moving through a particular location of the vehicle park. Some locations of a vehicle park might be of particular interest to the management of the vehicle park. Defining the event to be a vehicle moving through those particular locations can facilitate the management of the vehicle park by, for example, collecting evidences as to incidents occurred at those locations.

Preferably, the particular location of the vehicle park is prone to accident. Capturing images and videos at locations that are prone to accident helps the management of the vehicle park by, for example, collecting evidences as to accidents.

Preferably, the particular location of the vehicle park is an entrance or exit of the vehicle park. Capturing images and videos at the entrance(s) and exit(s) of the vehicle park helps the management of the vehicle park by, for example, collecting evidences as to the vehicle tailgating and information as to the malfunctioning of the gantries.

Preferably, the event is the presence of a vehicle at an originally unoccupied parking slot/lane or the absence of a vehicle at an originally occupied parking slot/lane. Defining the event as such facilitates the management of the vehicle park by, for example, collecting evidences as to incidents occurred when a vehicle moves into or out of a specific parking slot/lane.

Preferably, the event detection module is an image analysis module that analyses the images captured by the image capturing device to detect the occurrence of the event. Such an image analysis module utilizes the existing components of the present system (e.g., the image capturing device) to detect the occurrence of an event of interest, and accordingly does not require additional hardware components.

Preferably, the event detection module is a gantry system with at least a sensor. Such an event detection module is particularly suited for detecting events of interest at the entrance(s)/exit(s) of a vehicle park.

Preferably, the event file is tagged with at least one identification information. The tagging of identification information facilitates, for example, the search through the event files for a particular incident, the preparation of a report that collates the events, and accordingly reduces the need of manpower in analysing the event files.

Preferably, the identification information is selected from the group comprising of vehicle plate number, vehicle IU number, vehicle colour, vehicle model, exit lane number, entrance lane number, gantry number, date, time, premise name, premise address, vehicle park name and vehicle park address. Such identification information is particularly suited for facilitating, for example, the search through the event files for a particular incident and the preparation of a report that collates events.

Preferably, the event file is transmitted by the memory device to a server for long-term storage. The long-term storage of the event files in the server alleviates the need to employ memory device (comprising buffer memory) with large data storage capacity, and at the same time, facilitates the inspection of the event files in the long run.

Preferably, the server is operable to generate a report based on the event file. Such a function of the server can facilitate the inspection of the event files and ease the burden of time-and-effort in finding a specific event file as well as in analysing a group of event files together to understand the management of the premise.

Preferably, the buffer memory is a storage medium selected from the group comprising random-access memory (RAM), a hard disk, a flash memory, a compact flash (CF) card, a secure digital (SD) card, a smart media (SM) card, a

multimedia card (MMC), or a memory stick. These storage medium are particularly suited for temporarily storing the event files.

Preferably, the event detection module is integrated with the memory device. This integration can further alleviate data traffic congestion concern of the system since the electronic instruction from the event detection module to the memory device can be transmitted internally between the two without resorting to external data network.

Preferably, the event detection module is integrated with the server. This integration might simplify the system and reduce its costs.

In accordance with another aspect of the invention, there is provided a method for event detection at a premise comprising: capturing at least one image of the premise by an image capturing device at every predetermined time interval; receiving at least one image captured by the image capturing device by a memory device comprising a buffer memory arranged in data communication with the image capturing device; detecting an event by an event detection module; sending an electronic instruction to the memory device to store in the buffer memory an event file comprising at least an image before the event, an image at the time the event occurs and an image after the event. The present method mitigates the existing technical problems on using cameras for managing vehicle parking. First of all, as the information captured by the method (i.e., event file) includes the scenes (e.g., images or videos) before the event, at the time the event occurs as well as after the event, the event file can provide a complete picture of the event from the beginning to the end. Also, as only images or videos related to events of interest are stored, the data storage required for implementing the present invention is much smaller and more manageable. Furthermore, the method first stores the event file in a buffer memory. Such an arrangement alleviates the possible data traffic congestion between the image capturing devices and the backend server, particularly during the peak hours when the occurrence of event of interest is high.

Preferably, the method further comprises the step of transmitting the event file by the memory device to a server for long term storage. The method of storing the event files in the server for long term alleviates the need to employ memory device (comprising buffer memory) with large data storage capacity, and facilitates the inspection of the event files in the long run.

Preferably, the method further comprises the step of naming or tagging the event file with at least one identification information, wherein the identification information is selected from the group comprising vehicle plate number, vehicle IU number, vehicle colour, vehicle model, exit lane number, entrance lane number, gantry number, date, time, premise name, premise address, vehicle park name and vehicle park address. The method of tagging the event files with the identification information can facilitate, for example, the search through the event files for a particular incident and the preparation of a report that collates the event files.

Preferably, the method further comprises the step of generating a report based on the event file. Such a method can facilitate the inspection of the event files and ease the burden of time-and-effort in finding a specific event file as well as in analysing a group of event files together to understand the management of the premise.

In accordance with another aspect of the invention, there is provided a method for event detection at a vehicle park comprising: capturing at least one image of the vehicle park by an image capturing device at every predetermined time interval; receiving at least one image captured by the image capturing device by a memory device comprising a buffer memory arranged in data communication with the image capturing device; detecting an error by a gantry system of the vehicle park; sending an error message to a server by the gantry system; sending an electronic instruction to the memory device by the server to store in the buffer memory an event file comprising at least an image before the event, an image at the time the event occurs and an image after the event. The present method mitigates the existing technical problems on using cameras for managing

the entry and exit of vehicles at a vehicle park. First of all, as the information captured by the method (i.e., event file) includes the scenes (e.g., images or videos) before, during and after the entry/exit of the vehicles at the gantries of the vehicle park, the event files can be particular useful in serious circumstances (e.g., the evasion of paying the vehicle parking fees; vehicle tailgating) that require complete, reliable and convincing evidences. Also, as only images or videos related to events of interests (e.g., tailgating, barrier malfunctioning) are stored, the data storage required for implementing the present method is much smaller and more manageable. Furthermore, in the present method, the event file is not directly sent to the back-end server for long-term storage, and instead, employs a memory device comprising a buffer memory as an intermediary storage to store the images and videos. This arrangement of the present method alleviates the possible data traffic congestion between the image capturing devices and the backend server. For instance, during the peak hours when there are many vehicles moving in and out at the entrance(s)/exit(s) of the vehicle parks, the image capturing devices installed at the entrance(s)/exit(s) of the vehicle parks are all operating actively.

Preferably, the method further comprises the step of transmitting the event file by the memory device to a server for long term storage. The method of storing the event files in the server for long term alleviates the need to employ memory device (comprising buffer memory) with large data storage capacity, and facilitates the inspection of the event files in the long run.

Preferably, the method further comprises the step of naming or tagging the event file with at least one identification information, wherein the identification information is selected from the group comprising vehicle plate number, vehicle IU number, vehicle colour, vehicle model, exit lane number, entrance lane number, gantry number, date, time, premise name, premise address, vehicle park name and vehicle park address. The method of tagging the event files with the identification information can facilitate, for example, the search through the

event files for a particular incident and the preparation of a report that collates events.

Preferably, the method further comprises the step of generating a report based on the event file. Such a method can facilitate the inspection of the event files and ease the burden of time-and-effort in finding a specific event file as well as in analysing a group of event files together to understand the overall management of the premise.

The present invention is able to retrieve relevant event data files on demand when a predefined event of interest occurs, without comprising the storage size and data traffic flow. This is achieved through an intelligent selective storage of relevant event data files in the backend server as will be further elaborated in the embodiments.

Other aspects of the invention will become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows an illustrative view of the overall system.
Figure 2 is an illustrative flowchart of the decisions made by the system in use.
Figure 3 shows another illustrative view of the overall system.
Figure 4 shows another illustrative view of the overall system
Figure 5 shows another illustrative flowchart of the decisions made by the system in use.
Figure 6 shows an illustrative view of a memory device comprising a buffer memory having at least a first portion and a second portion; and

Figure 7 shows another illustrative view of a memory device linking to a buffer memory having at least a first portion, a second portion and a third portion.
Figure 8 shows an illustrative view of the generation of an event file.

Other arrangements of the invention are possible and, consequently, the accompanying drawings are not to be understood as superseding the generality of the preceding description of the invention.

Furthermore, for the purpose of clarity and conciseness, a similar integer format has been consistently applied in Figure 1, Figure 3, Figure 4, Figure 6 and Figure 7 to label the components of the system.

PREFERRED EMBODIMENTS OF THE INVENTION

Particular embodiments of the present invention will now be described with reference to the accompany drawings. The terminology used herein is for the purpose of describing particular embodiments only and is not intended to limit the scope of the present invention. Additionally, unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one or ordinary skill in the art to which this invention belongs. Where possible, the same reference numerals are used throughout the figures for clarity and consistency.

The following embodiments are particularly suited for the vehicle park management today. Many vehicle parks have been ubiquitously installed with image capturing devices (e.g., surveillance cameras; closed-circuit television (CCTV) cameras; IP-based cameras). These image capturing devices, forming an integral part of modern vehicle park management, provide the necessary infrastructure and hardware for implementing the present invention. Other than vehicle parks, the present invention is also applicable or relevant for event detection at any premise that is equipped with surveillance, monitoring and recording devices (e.g., surveillance cameras; closed-circuit television (CCTV)

cameras; IP-based cameras). Examples of such premises include, but not limited to, gasoline stations, industrial facilities, commercial enterprises, residential areas, streets, schools, hospitals, camps and parks.

The following embodiments of the present invention provide various technical advantages over the prior art. First of all, the embodiments can store salient information related to an event of interest while saving storage space. Conventionally, the image capturing devices, by taking snapshot images at various sites and time points, from various angles and directions, may capture information critical for managing vehicle parks. However, while such snapshot images might be useful and informative in some circumstances, a significant disadvantage of taking snapshot images is that only static information at a particular time point is captured. Such snapshots images accordingly might not be able to provide complete and reliable information for serious issues (e.g., car damage disputes; vehicle/vehicle, vehicle/pedestrian collision disputes; car damage insurance claims) that require convincing evidence. A more efficient way of managing snapshot images is therefore required without resulting in an over-burden of the system in terms of memory storage requirements to provide the necessary convincing evidence for an event of interest.

In this regard of efficient management, another important advantage of the following embodiments is that their implementations alleviate the need for large memory storage space for electronic data. While, in theory, the image capturing devices inside the vehicle parks can be arranged to continuously capture images at a high frame rate (e.g., a frame rate more than 25 FPS) so that all events occurred are recorded in full, other practical challenges arise. Continuous image capturing at a high frame rate generates a huge amount of electronic data that are difficult to be properly stored and managed. For example, if the cameras are switched to video-recording mode (e.g., capturing images at a high frame rate, (e.g., more than 25 FPS) and formatting the images into video clips), the images/videos captured can take up so much data storage capacity that a 1TB (terabyte) or 2TB hard disk can merely last for a month or two. Furthermore,

even if cost is not a concern to the management of the vehicle park and there are abundant data storage space available, it is still labour-intensive and time-consuming to analyse the contents of the images/videos: extensive manpower is likely required to look for the events of interest from hours and even days of video footages. The following embodiments of the present invention alleviate the need for large data storage space by only storing images/video clips related to the events of interests.

The events of interests herein refer to anything in a vehicle park that the vehicle park management is interested to monitor and record. For example, such events of interests may include, but not limited to:

i. capturing and recording events (e.g., the scratches between cars; parking lot/lane collision; "backing-over" injuries to pedestrians) occurred when a vehicle moves into (or out of) a particular parking slot/lane;
ii. capturing and recording events (e.g., accident) occurred when a vehicle moves through a particular place inside a car park that is prone to accident;
iii. capturing and recording events occurred when a vehicle moves through an entrance/exit (e.g., gantry) of a vehicle park; and
iv. capturing and recording events associated with any error message and/or abnormal message generated by the management system of the vehicle park.

Such a management system may include, but not limited to,

i. an image capturing device 120 operable to capture at least one image of the premise at every predetermined time interval;
ii. a memory device 110 comprising a buffer memory arranged in data communication with the image capturing device 120, the memory device 110 for receiving the at least one image captured by the image capturing deice 120;

iii. a server 100 arranged in data communication with the memory device 110;

iv. a gantry system 140 arranged in data communication with the server 100;

v. a gantry processor 130 that is operable to facilitate the data communication between the gantry system 140 and the server 100, and

vi. a sensor 360 installed on the gantry system that is capable of detecting events of interest occurred at the gantry system 140 (e.g., vehicle tailgating, mechanical failure of barrier, barrier being knocked down, barrier arm hanging due to power trip).

In accordance with a specific embodiment of the invention there is a system for managing a vehicle park as shown in Figure 1 that has a server 100 arranged in data communication or linked 105 to a memory device comprising a buffer memory 110. The server 100 is a computer server comprising at least one processor. The at least one processor may be arranged in a distributed environment or may be a cloud server as colloquially known.

The link 105 transmits and receives data between the server 100 and the memory device 110. The link 105 may be a wired or wireless data communication channel utilizing well-established data communication protocol, such as Transmission Control Protocol/Internet Protocol (TCP/IP). Alternatively, the link 105 may be a power-line communication (PLC) (also known as power-line carrier, power-line digital subscriber line (PDSL), power-line telecommunications, power-line networking), a communication protocol that uses electrical wiring to simultaneously carry both data, and Alternating Current (AC) electric power transmission or electric power distribution.

The server 100 processes all the information and can provide automated decision making although this is typically prompted or triggered by a user in the control room.

The memory device 110 may be a video recorder 110 comprising a buffer memory disposed therein that is utilized to store images, videos and any type of electronic files. The memory device 110 therefore provides a memory space independent from that the memory space found inherently on the server 100. The buffer memory within the video recorder 110 typically has a smaller data storage capacity than the memory space in the server 100, and functions as follows in some embodiments of the invention:

i. A first portion or the whole of the buffer memory is used for temporary storage of data files recorded by the video recorder 110, such that the data files within the buffer storage may be overwritten once the buffer memory is full;

ii. In the case where a first portion of the buffer memory is utilized for temporary storage of data files, a second portion of the buffer memory may be carved out for storage of data files associated with one or more events of interest. This second portion will not be overwritten but the event data files will be transmitted to the server 100 upon receipt of an electronic instruction. Once successfully transferred to the sever 100, the data in the second portion is then cleared to make space for future event data files. Alternatively, the event files will be transmitted to the server 100 once the second portion is filled.

In an embodiment of the invention, the memory device 110 can be a digital video recorder (DVR) 110 which is linked (115) to an image capturing device 120 and receives the image or video signal from the image capturing device 120 accordingly. The DVR 110 may be integrated with the image capturing device 120, or located as a stand-alone apparatus in the network. Alternatively, the DVR 110 may be integrated with the server 100. The link 115 transmits and receives data between the video recorder 110 and the image capturing device 120. The link 115 may be a wired or wireless data communication channel utilizing well-established data communication protocol, such as Transmission Control Protocol/Internet Protocol (TCP/IP). Alternatively, the link 115 may be a power-

line communication (PLC) (also known as power-line carrier, power-line digital subscriber line (PDSL), power-line telecommunications, power-line networking.

Alternatively, the memory device 110 is a network video recorder (NVR) that is linked via a network cable 115 to the image capturing device 120 (e.g., a digital camera, a CCTV camera or an internet protocol (IP) camera), which sends and receives data via a computer network (e.g., internet, intranet, extranet) 115. The NVR 110 may be integrated with the image capturing device 120, or located as a stand-alone apparatus in the network. Alternatively, the NVR 110 may be integrated with the server 100.

Both DVR and NVR 110 have a network connection port that allows connectivity with the rest of the system. In some embodiments of the invention, the link 105 is a network cable and allows the server 100 to control the DVR/NVR 110 functions for receiving and storing images/videos sent from the image capturing device 120 into the buffer memory of the DVR/NVR 110, and only upon triggered or instructed, retrieving the images/videos associated with an event of interest and storing them as an event file in the buffer memory of the DVR/NVR 110. Alternatively, in embodiments wherein the buffer memory of the DVR/NVR 110 comprises at least a first portion and a second portion, the images/videos sent from the image capturing device 120 are stored in the first portion, and the event files are stored in the second portion. Alternatively, the event files, upon generation, are directly transferred to and stored in the server 100.

In some embodiments, the images/videos stored in the buffer memory of the memory device 110 may be overwritten once the buffer memory (or the first portion thereof) is full. In some embodiments, the event files will be transmitted to the server 100 once the buffer memory (or the second portion thereof) is full.

In some embodiments, the event files may be images or video clips. In some embodiments, the event file may be tagged with identification information, which may include, but not limited to, vehicle plate number, vehicle IU number, vehicle colour, vehicle model, exit lane number, entrance lane number, gantry number,

date, time, premise name, premise address, vehicle park name and vehicle park address. The identification information may be tagged to the event file either by the DVR/NVR 110 or the server 100.

In another embodiment of the invention, wherein the image capturing device 120 is operable to capture at least one image of the gantry at every predetermined time interval and the memory device 110 is arranged to receive the at least one image captured by the image capturing device 120 and store the at least one image into the buffer memory of the memory device 110, should a sensor at the gantry system 140 senses an error triggered by an event at the gantry (e.g., vehicle tailgating, mechanical failure of barrier, barrier being knocked down, barrier arm hanging due to power trip), the gantry system 140 will send an error message to the server 100 via the link 125. The server 100, upon receiving the error message indicating that an event of interest has occurred, then sends an electronic instruction to the particular memory device 110 (e.g., DVR/NVR) that is associated with the relevant sensor to store an event file comprising at least an image before the event, an image at the time the event occurs and an image after the event into the buffer memory of the memory device 110. Alternatively, in embodiments wherein the buffer memory of the memory device 110 comprises at least a first portion and a second portion, the at least one image captured by the imaging capturing device 120 is stored in the first portion, and the event file generated upon receiving the error message is stored in the second portion. Alternatively, the event file first stored in the buffer memory of the memory device 110 is subsequently transferred to the server 100 for long-term storage via the link 105 by file transfer protocol (FTP) mode. An operator who has access to the server 100 would then be able to view the event file from the server accordingly and possibly review the footage for the day or week.

In another embodiment of the invention, the identification information associated with the event, e.g. IU number, exit lane number, date, time, carpark name etc, is embedded in the event file as identification tags (e.g., in the form of file name,

watermark). The identification tags can be added to the event file either by the memory device 110 or the server 100.

In another embodiment of the invention, the memory device 110 is linked to an image capturing device 120 that captures at least one image of the scene including the gantry system and the entrance or exit of the vehicle park. The memory device 110 is a video recorder, and the image capturing device 120 is a video camera. The video camera is of sufficient resolution such that features of the individual vehicles such as the number plate, colour of the vehicle, type of vehicle, model and make of vehicle and even the general details of the person driving the vehicle can be distinguished and identified.

The memory device 110 can be set to receive images/videos from the image capturing device 120 and store the received images/videos continuously into the buffer memory, and only when required, triggered or instructed by the server 100, retrieve and store the selected images/videos associated with an event of interest as an event file into the buffer memory. Alternatively, in embodiments wherein the buffer memory of the memory device 110 comprises at least a first portion and a second portion, the continuously received and stored images/videos are stored in the first portion, and the event file generated when required, triggered or instructed by the server 100 is stored in the second portion. The first portion and the second portion of the buffer memory may be electronic file folders, drives, disks or any other types of memory compartments. In some embodiments, the first portion and the second portion are different types of memory devices: for example, the first portion is a random-access memory, while the second portion is a hard disk.

Alternatively, the event file can be stored at the memory device 110 for a period of time but will have to be transferred to the server 100 for permanent storage before the buffer memory gets full. Alternatively, the memory device 110 does not store any event file in its buffer memory, and instead, immediately transfers the event file to the server 100 for storage.

In some embodiments, the images and video feeds from the image capturing device 120 can be fed and viewed real time at the server 100, and should the user require it, the user can manually trigger the memory device 110 to store what is being shown. When the memory device (e.g., video recorder) 110 is triggered to store the images/videos associated with the event of interest happening (or happened) on site, the memory device 110 stores an electronic file (event file) comprising the scene starting at a predetermined or set time before the instruction to store is triggered, say 30 seconds, 10 seconds or 20 seconds in accordance with the user's preference. This is possible because the memory device 110 is continuously receiving and storing the images or video feeds into the buffer memory of the memory device 110. The memory device 110, only upon manually or automatically triggered or instructed, retrieves the images/videos captured from a predetermined or set time before the trigger or instruction from the buffer memory, and stores the retrieved images/videos as a selected event data file in the buffer memory of the memory device 110. In some embodiments wherein the buffer memory of the memory device 110 comprises at least a first portion and a second portion, the images or video feeds are stored in the first portion, and the event data files are stored in the second portion. The first and second portions of the buffer memory may be electronic file folders, drives, disks or any other types of memory compartments. In some embodiments, the first portion and the second portion are different types of memory devices: for example, the first portion is a random-access memory, while the second portion is a hard disk.

This present invention therefore alleviates the need for large digital data storage space. In some embodiments of the invention, the memory device 110 would only stop retrieving and storing the images/videos as the event data files when the server 100 sends an electronic instruction to stop the memory device 110 or if a preset period of time has passed, e.g. two (2) minutes.

In another embodiment of the invention, the data communication between the server 100 and the gantry system 140 can be further facilitated by a gantry

processor 130. The gantry processor 130 controls the barrier arm 150 on a gantry system 140 via a local wire or cable 135. Alternatively, the gantry system is in direct data communication with the server, and does not require the facilitation of a separate processor like the gantry processor 130.

When an error message is sent by the gantry processor 130 indicating an error in the gantry system 140 or directly by the gantry system 140 itself, the server 100 instructs the memory device 110 that an error or an event of interest has occurred, and the memory device 110 identifies and collates the images/videos captured in, for example, the previous 30 seconds before the event, the actual event itself as well as the 30 seconds after the event. The memory device 110 then saves these images/videos as an event file and tags it accordingly with identification information of the event. In some embodiments, the tagging can be in the form of using the time, type of error, place of error and/or vehicle features as the file name. In some embodiments, the tagging can be embedding the time, type of error, place of error and/or vehicle features into the images/videos as watermark.

The event file containing the images/videos before, during and after the event of interest is then sent by the memory device 110 back to the server 100, which stores the event file for further review. The user can also be prompted that there are event files for further review. In some embodiments, the server 100, upon receiving the event file sent from the memory device 110, would tag or rename the event file. The server 100 is able to generate reports based on one or more event files either upon demand or periodically, such that an operator is able to view all the incidents in a day or in a week or in a month, and filter the event files by the identification tags such as event type, date, vehicle park, vehicle feature etc. Each incident would have at least one associated event file that can be easily reviewed for further verification or evidence. In some embodiments, an incident may have a plurality of the associated event files when there are multiple image capturing devices 120 capturing the same incident (possibly from different angles or perspectives).

In some embodiments, the memory device 110 is a video recorder, the event file is a video clip and the image capturing device 120 is a video camera.

The error message sent by the gantry system 140 to the server 100 can be in any electronic format. In some specific embodiments of the invention, the error message is a SMS, MMS, iMessage, IP-based message or any other types of electronic message.

In a specific embodiment of the invention, the gantry system has a lighting device (e.g., an LED signboard) installed on the barrier arm to indicate to the motorists that the gantry system has detected an error and an error message has been sent to the memory device to store an event file that records the event that triggers the error. The LED signboard can display messages such as “tailgating is illegal”, “fee evasion will be recorded and captured” or the like.

The gantry system 140 can also be equipped with one or more safety sensors to prevent the barrier arm 150 from falling on a vehicle. These safety sensors can be in the form of a photodetector sensor or a laser sensor or a magnetometer sensor placed on the ground, and careful placement or positioning of the sensors would aid in detecting if only one vehicle is allowed through at a time. For more advanced version, the sensor can be upgraded to curtain photodetector to further detect whether only one vehicle has passed. Multiple sensors can also be used in combination to provide added security. In the event that the sensors detect that more than one vehicle has passed, the gantry processor 130 triggers an event, which causes the server 100 to instruct the memory device 110 that an event has occurred, which means the images or video feeds from the image capturing device 120 from before the event until the event is over is stored and tagged accordingly, and sent to the server 100 for further review by the operator. The memory device 110 (e.g., DVR/NVR) can use a watermark function to label the images/videos of the event file with the vehicle IU number, exit lane number, date, time, carpark name etc, which provides incontrovertible and incorruptible proof of any alleged violation since there is a high degree of difficulty in editing or changing the watermark. A further level of transparency is put in place by the file

being transferred via FTP which would have the file name and transaction number linked to the corresponding event files.

Should a vehicle be found to evade payment before exiting the vehicle park from the review by the operator, the vehicle details can be captured and logged into a watchlist or blacklist, such that the next time the same vehicle enters the vehicle park, the system would note that the vehicle is on a blacklist and appropriate action may be taken against the vehicle, such as wheel clamping or informing the authorities. The image/video evidence (i.e., the event file) gathered would provide incontrovertible proof that the vehicle (and even vehicle owner if the image was sharp enough) had evaded payment after using the vehicle park.

The server 100 may also trigger the memory device 110 to store an event file should the gantry processor 130 indicate to the server 100 that a manual override on site was triggered to raise the barrier arm 150 via the gantry system 140. On site operators can legitimately manually raise the arm if there were some problems with the gantry processor 130 in processing the payment for example. This would prevent on site operators from misusing the manual override as the process is recorded and stored.

The system of Figure 1 will next be described in the context of operation as depicted in Figure 2.

A method is also disclosed in accordance with invention and a flowchart of the method is shown in Figure 2. This is usually done for the exit gantry rather, although it can also be adapted for the entry gantry, especially if payment were collected upon entry (per entry fee). The process begins 200 when a vehicle approaches the gantry, this can be enhanced by using sensors to determine this. The system performs a self-check 210 on the gantry to ensure that the gantry is in place. This verification can also be done via a video camera through image recognition software to check that the barrier arm is in position (the video camera may be the image capturing device 120 or another video camera specially adapted for performing this verification). Should there be an error associated with

an event which is occurring in the gantry system, an error report is generated 220 together with an alert to the operator so that personnel can be dispatched onsite to rectify the error. At the same time, the video recorder (the memory device 110) is triggered to extract the images/videos related to the event of interest, and store these extracted images/videos into an event file and tag the event file 222 accordingly. This self-check 210 ensures that the gantry error can be triggered and the images/videos related to the event of interest can be properly stored.

When the vehicle is stopped before the gantry, the amount of money to be charged is calculated either by scanning a ticket presented by the vehicle driver or by scanning the vehicle IU 240. The database is then queried on the amount to be charged and payment is collected 250. The collection of payment 250 can be through the deduction of the cashcard through the IU or via the gantry processor 130 and verification of successful payment is carried out 260. Should payment be unsuccessful for any reason, an error report can be generated 220 and the video recorder 110 would save the recording into an event file and tag the event file 222 accordingly. Should there be a need to raise the gantry manually 224, the onsite operator can do so via a manual override, or the operator at the server can also do so remotely. The safety sensor can also activate the raising of the gantry manually 224 should the gantry processor detect via the sensor that safety is at risk, at the same time this would trigger an error report and causes the images/videos related to the event to be stored as an event file and tagged accordingly. Thereafter the system only stops storing the images/videos as the event file once the gantry is lowered successfully, ensuring that the event file captures the scene of the entire event and the process restarts 200. Successful payment can also occur for older parking systems where payment is made just before the vehicle driver gets into the vehicle and is issued a validated ticket which can be processed by the gantry processor accordingly. If payment was successful or the cashcard deduction was successful, the gantry or barrier arm is raised 265 and the system waits for the vehicle to pass through 270 and once the system has detected that the vehicle has passed, the barrier is lowered 275. Should there be any reason why the barrier cannot be lowered, like

an obstruction or a second vehicle, a gantry error is reported 210 and the images/videos associated with the event of interest are saved as an event file 222.

A further embodiment of the system can be seen in Figure 3 where it shows the instance where a vehicle 310 that has successfully made payment and is moving through the exit of the vehicle park after the barrier arm 350 has been raised. A similar integer format as Figure 1 has been preserved for clarity and conciseness. The diagram also shows a tailgating vehicle 315 that is following the first vehicle 310 closely. Existing systems would either not detect that there are two vehicles or the barrier arm 350 would try to be lowered but be overridden by the gantry processor 330 as the sensor loop 360 on the ground senses that there is an obstruction in the way of the barrier arm 350 lowering. However, the diagram also shows a second sensor 360 that projects a sensor curtain 365 that can differentiate that there are two different vehicles passing through the exit since it is inevitable that there is a gap between the vehicles that triggers the curtain detection point 367. This then triggers the camera system 320 to generate an event file comprising at least an image before the tailgating, an image during the tailgating and an image after the tailgating. Upon the generation of the event file, the gantry processor 320 sends a notification message to the server (not shown in Figure 3) along with the event file. The event file is then stored into the database of the server for further review. Alternatively, the event file is stored in the camera system 320, and only a link to the event file is sent together with the notification message to the server by the gantry processor 320. In some embodiments of the invention, the event file may be tagged with the details of the vehicle tailgating event (e.g., IU number, exit lane number, date, time, carpark name etc) either at the camera system 320 or at server.

In some embodiments, the camera system 320 comprises an image capturing device and a memory device. The memory device continuously receives and stores the images/videos captured by the image capturing device into the buffer memory of the memory device, and only upon the triggering of the curtain

detection point 367, intelligently retrieves the images/videos before, during and after the vehicle tailgating and stores the retrieved images/videos as an event file into the buffer memory of the memory device. Alternatively, in embodiments wherein the buffer memory comprises a first portion and a second portion, the images/videos are stored in the first portion, and the event files are stored in the second portion. Alternatively, the event file is not stored in the buffer memory, and instead, directly sent to the server for storage. Alternatively, the camera system 320 is a single apparatus having multiple functions for capturing images/videos, storing the images/videos, retrieving the images/videos related to an event of interest and further saving the retrieved images/videos as an event file.

In some embodiments, the images/videos stored in the buffer memory of the camera system 320 may be overwritten once the buffer memory (or the first portion thereof) is full. In some embodiments, the event files will be transferred to the server once the buffer memory (or the second portion thereof) of the camera system 320 is full.

This sensor curtain 365 can use conventional photodetectors or lasers for more accuracy and can be tasked to switch on only when the barrier arm 350 is lifted.

The gantry processor can also be tasked to collect payment from the vehicle either via a paid ticket or a cashcard or a concession pass.

A further embodiment of the system can be seen in Figure 4 where it shows that a server 400 that is linked 405 to a memory device comprising a buffer memory 410. In some specific embodiments, the memory device 410 is a video recorder. The link 405 transmits and receives data between the server 400 and the memory device 410 and can be a TCP/IP connection carried out wirelessly (e.g., WI-FI, Bluetooth) or through cables. Another way of transmitting and receiving data between the server 400 and the memory device 410 is using power-line communication (PLC) (also known as power-line carrier, power-line digital subscriber line (PDSL), power-line telecommunications, power-line networking),

a communication protocol that uses electrical wiring to simultaneously carry both data, and Alternating Current (AC) electric power transmission or electric power distribution.

The server 400 processes all the information and can provide automated decision making although this is typically prompted or triggered by a user in the control room. The memory device 410 can function as a storage device used to receive and store images or videos captured by the image capturing device 420 in the buffer memory, and only upon required, triggered or instructed by the event detection module 440, stores the images or videos related to an event of interest as an event file into the buffer memory of the memory. In embodiments wherein the buffer memory of the memory device 410 comprises at least a first portion and a second portion, the images or videos captured are stored in the first portion, and the event files are stored in the second portion.

Accordingly, the memory device 410 provides a buffer memory space separate from the memory space found inherently on the server 400.

In a specific embodiment, the memory device uses random-access memory (RAM), a hard disk, a flash memory, a compact flash (CF) card, a secure digital (SD) card, a smart media (SM) card, a multimedia card (MMC), or a memory stick to store the event files.

This memory device 410 can be a digital video recorder (DVR), which is linked (405) to the image capturing device 420 (e.g., camera) and receives the image or video signal from an image capturing device 420 (e.g., camera) accordingly. Alternatively, a network video recorder (NVR) can be used as the memory device 410 which is linked via a network cable 415 to the image capturing device 420 (e.g., camera or an Internet Protocol (IP) camera), which sends and receives data via a computer network (e.g., internet, intranet, extranet). The NVR may be integrated with the server, or integrated with the image capturing device 420, or located as a stand-alone apparatus independent from the server 400 and the image capturing device 420.

Both DVR and NVR have a network connection port that allows connectivity with the rest of the system. The link 405 is a network cable and allows the server to control the DVR/NVR to receive and store the scenes of a premise, only upon triggered or instructed store scenes related to an event of interest as an event file, as well as tag the event file with the corresponding event information (e.g., vehicle plate number, vehicle IU number, vehicle colour, vehicle model, exit lane number, entrance lane number, gantry number, date, time, premise name, premise address, vehicle park name and vehicle park address etc).

In some embodiments of the invention, there is an event-detection module 440 arranged in data communication either with the server 400 or directly with the memory device 410. The event-detection module 440 is operable to detect an event of interest and to send a message to the server 400, which upon receiving the message, sends an electronic instruction to the memory device 410 to store the images/videos related to this particular event of interest as an event file. The event detection module 440 can also directly instruct the memory device 410 to store the images/videos related to the particular event of interest as an event file.

In a specific embodiment of the invention, should the event-detection module 440 (e.g., an image analysis module) detect a vehicle moving into a parking slot/lane by comparing a stream of images captured in sequence, an event file storage command will be sent to the particular memory device 410 (e.g., DVR/NVR) linked to the relevant event-detection module 440 to store the images/videos associated with the vehicle moving into a parking slot/lane as an event file. In some embodiments, all information associated with the event, e.g. vehicle plate number, vehicle IU number, vehicle colour, vehicle model, exit lane number, entrance lane number, gantry number, date, time, premise name, premise address, vehicle park name and vehicle park address etc, may be embedded into the images or video clips or the event file. The event file generated may be kept in the memory device 410 or transferred to the server 400 via the link 405 by file transfer protocol (FTP) mode. The operator, who has the access to the server,

would be able to view the event file from the server accordingly and possibly review the footage (e.g., images or video clips) for the day or week.

In some embodiments, the event files (e.g. video clips) are stored at the server 400 for a long-term using either a HDD (hard disk drive) or a SSD (solid state drives).

In a specific embodiment, the event detection module 440 is an image analysis module. The image analysis module is capable of determining whether a specific parking slot/lane is occupied or empty. The built-in software of the image analysis module compares the image of the empty slot and the captured images, and confirms the parking slot/lane occupied if a few captured images show the parking slot occupied. The image analysis module then transmits the status information of the parking slot to the memory device 410 either directly or via the backend server 400. The memory device 410, upon receiving the status update of the parking slot, stores in its buffer memory an event file comprising at least an image before the event (e.g., the vehicle moving-in), an image at the time the event occurs and an image after the event. Similarly, for an occupied parking slot, the built-in software of the image analysis module compares the image of the occupied slot and the captured images, and confirms parking slot has become empty after the vehicle has moved out if a few captured images show the parking slot empty. The image analysis module then transmits the status information of the parking slot to the memory device 410 either directly or via the backend server 400. The memory device, upon receiving the status update of the parking slot, stores an event file comprising images before, during and after the vehicle moving out of the parking slot. In another specific embodiment, the image analysis module analyses the captured images to generate identification information of the vehicle (e.g., vehicle plate number, vehicle IU number, vehicle colour, vehicle model), stores the identification information as electronic data (e.g., text) and tags the identification information to the related event files. An example of tagging the event file is to embed the identification information into the images or videos of the event file as watermark. Another example of tagging

the event file is to incorporate the identification information (e.g., text) into the file name of the event file.

The memory device 410 is linked to an image capturing device 420 that captures images related to the events of interest such as:

- a vehicle moving into or out of a parking slot;
- the presence of a vehicle at an originally unoccupied parking slot;
- the absence of a vehicle at an originally occupied parking slot;
- a vehicle moving through a particular location of the vehicle park, the particular location can be an area that is prone to accident (e.g., car prangs/crashes/collisions), an entrance of the vehicle park, or an exit of the vehicle park.

As appreciated by a person skilled in the art, the above described "events" of interest are merely examples of occurrences, happenings, matters or circumstances that are of interest to the management of a premise such as a vehicle park. Depending on the implementation, other occurrences, happenings, matters or circumstances might be of interests depending on the applications desired. For example, the presence of a pedestrian at a particular location of the vehicle park might be an event of interest to its management. Occurrences, happenings, matters or circumstances taken place in other premises (e.g., school, hotel lobby, factory and hospital) might be events of interest to the respective managements of the premises as well.

The image capturing device 420 is of sufficient resolution such that features of the individual vehicles such as the number plate, colour of the vehicle, type of vehicle, model and make of vehicle and even the general details of the person driving the vehicle can be distinguished and identified. The image capturing device 420 can be a video camera, a CCTV camera, an IP-based camera or any type of surveillance camera.

The memory device 410 can be configured to receive and store the images/videos captured by the image capturing device 420 all the time in the

buffer memory of the memory device 410, and only storing the event files (e.g., selected images/video clips that are associated with an event of interest) in the buffer memory when required, or triggered or instructed by the server 400, or directly triggered or instructed by the event detection module 440. In some embodiments wherein the buffer memory comprises at least a first portion and a second portion, the images/videos are stored in the first portion, and the event files are stored in the second portion. In some embodiments, the images/videos will be overwritten once the buffer memory (or the first portion thereof) of the memory device 410 is full. In some embodiments, the event files will be transferred to the server 400 for storage once the buffer memory (or the second portion thereof) is full.

In another embodiment of the invention, the images or video feeds from the image capturing device 420 can be fed and viewed real time at the server 400, and should the user require it, manually trigger the memory device 440 to record and store what is being shown. When the server 100 instructs the memory device 440 to store the images or videos of an event of interest as an event file, the memory device 110 stores an event file comprising the images starting at a set time before the instruction is given, say 30 seconds. This is possible because the memory device 410 is configured to be permanently receiving and storing images/videos from the image capturing device 420 in its buffer memory, but retrieve and store only what is required (e.g., those images/videos related to an event of interest) as an event file in its buffer memory. In some embodiments, the images/videos that are not stored as event file are promptly overwritten once the buffer memory is full. In some embodiments, the event files are transferred to the server 400 once the buffer memory of the memory device 410 is full. These arrangements alleviate the need for large memory space at both the memory device 410 and the server 400, since only the event files are stored in the long-term, and the images/videos not related to any event of interest are promptly overwritten to clear memory space. In some embodiments of the invention, the memory device 410 would only stop storing the event files when the server 400 instructs or if a preset period of time has passed, e.g. two (2) minutes.

In an embodiment of the invention, the server 400 is also linked 425(a) to the event detection module 440, which functions to detect the occurrence of an event of interest. In a specific embodiment of the present invention, the event detection module 440 is an image analysis module (or an image recognition software) that compares a steam of images captured by the image capturing device 420 in sequence to detect that a vehicle is moving into or out of a parking slot (or a vehicle is moving through a particular location of the vehicle park). In another embodiment of the present invention, the event detection module 440 detects an event occurrence by extracting and analysing "image data" of the images captured by the image capturing device 420. The term "image data" include data, but are not limited to: focus data, brightness data, colour data, or motion data. In another embodiment of the present invention, the event detection module 440 tracks and detects objects (e.g., vehicles) over the image sequence amounts to matching these different regions in order to determine the trajectories of the objects (e.g., vehicles). This matching can be done using objects templates (e.g., the physical shape of a vehicle), colour or texture. In another embodiment of the present invention, the event detection module 440 utilizes temporal gradients, accumulated gradients and optical flow to detect the variations among the captured images and accordingly detect moving objects (e.g., vehicles).

When an electronic instruction is sent by the event detection module 440 indicating an event in the particular parking slot or location, the server 400 receives the electronic instruction via the link 425(a) and instructs the memory device 410 that an event has occurred via the link 405, and the memory device 410 then stores, for example, the previous 30 seconds before the event, the actual event itself as well as, for example, 2 minutes after the event as an event file. In an alternative embodiment of the invention, the electronic instruction is transmitted by the event detection module 440 directly to the memory device 410. In another alternative embodiment of the invention, the event detection module 440 and the memory device 410 are integrated into a single apparatus. In yet another alternative embodiment of the invention, the event detection module 440 is integrated into the server 400.

In some embodiments, the memory device 410 then stores the event file and tags it accordingly with the identification information of the event. The tagging can be in the form of using the date, the time, the type of event (e.g., a vehicle moving into (or out of) a parking slot; a vehicle moving through a particular location of the vehicle park; a vehicle moving through the gantry of the vehicle park), the identification number of the parking slot, the name or address of the vehicle park, the identification number of the vehicle (e.g., vehicle IU number, vehicle plate number) or the characteristics of the vehicle (e.g., the colour, the model) as the file name or the watermark label. In some embodiments, the event file containing the images or video clips related to the event of interest is then sent by the memory device 410 to the server 400, which stores the event file for further review. The user can also be prompted that there are event files for further review. In some embodiments, the server 400, upon receiving the event file from the memory device 410, may tag or rename the event file accordingly. In some embodiments, the server 400 is able to generate reports based on one or more event files either upon demand or periodically, such that an operator is able to view all the incidents in a day or in a week, filtering them by type of event, date, time, vehicle park number or address, parking slot number, vehicle characteristics (e.g., colour or model) etc. Each event would have at least one associated event file that can be easily reviewed for further verification or evidence. In some embodiments, an event may have a plurality of the associated event files when there are multiple image capturing devices 420 capturing the same event (possibly from different angles or perspectives).

The event file can be either formatted into a single video clip (e.g., MOV, MP4, WMV, AVI, webm, flv, f4v) or a format that consists of a group of still images (e.g., JPEG, TIFF, GIF, BMP, PNG, PPM, webp).

The system of Figure 4 will next be described in the context of operation as depicted in Figure 5.

A method is also disclosed in accordance with invention and a flowchart of the method is shown in Figure 5. The image capturing device 420 is configured to

capture scenes (e.g., images or video clips) of a premise all the time (500), and a memory device 410 linked to the image capturing device 420 is to configured to continuously receive and store the images captured by the image capturing device 420 (510). The event detection module 440 constantly checks for the occurrence of an event of interest (520) (e.g., vehicle movement into or out of a particular parking slot; vehicle movement at a particular location of the vehicle park such as an entrance/exit of the vehicle park or a location that is prone to accident).

In some embodiments, the event detection module 440 may be:

i. a gantry system installed with a safety sensor to detect the mechanical failure of the gantry and the vehicle tailgating;
ii. an apparatus that can capture and analyse image(s) to detect the vehicle and/or pedestrian movements;
iii. an alarm that can be manually or remotely triggered; or
iv. an infrared sensor that is configured to detect whether a vehicle has moved into a particular location that does not allow vehicle parking.

Alternatively, the event detection module 440 may be integrated with the image capturing device 420. The event detection module 440 receives the images/videos from the image capturing device 420, and analyses the images/videos utilizing an image analysis software (or an image recognition software) to check, for example, whether a vehicle is moving in (or out of) a particular parking slot/lane or moving through a particular location of the vehicle park (e.g., an entrance or an exit or a location that is prone to accident).

Should there be an event of interest detected by the event detection module 440, the memory device 410 is then triggered directly by the event detection module 410 or indirectly through the server 400 to store images/videos related to the event of interest as an event file in the buffer memory of the memory device 410 (540). The event file can be further sent by the memory device 410 to the server 400 for long-term storage (550). In some embodiments of the invention, the event

file is tagged with identification information of the event either by the memory device 410 or the server 400.

In the absence of any event detected, the images/videos stored by the image capturing device 420 in the buffer memory of the memory device 410 are promptly overwritten once the buffer memory is full (530). In some embodiments, the event files are sent from the memory device 410 to the server 400 when the buffer memory of the memory device 410 is full.

In a further embodiment of the present invention, the memory device 410 stores the images captured by the image capturing device 420 in a random-access memory (RAM). The memory device 410 might also utilize other storage medium, such as a hard disk, a flash memory, a compact flash (CF) card, a secure digital (SD) card, a smart media (SM) card, a multimedia card (MMC), or a memory stick. The storage space of the memory device 410 and the length of each event file stored are carefully adjusted to ensure that the images captured can reflect the event in its entirety. In an embodiment of the present invention, the memory device 410 can store about 10 event files.

In another embodiment of the invention, as illustrated in Figure 6, the buffer memory of the memory device 610 comprises at least a first portion 660 and a second portion 670. The first portion 660 is arranged to continuously receive and record the images/videos captured by the image capturing device 620. The second portion 670 is arranged to store the event files that comprises the images/videos related to the events of interests. The first and second portions of the buffer memory may be electronic file folders, drives, disks or any other types of memory compartments. In some embodiments, the first portion and the second portion are different types of memory devices: for example, the first portion is a random-access memory, while the second portion is a hard disk.

For example, when the event detection module 640 detects an event of interest, the memory device 610 will receive an electronic instruction either directly from the event detection module 640 (via the link 625(b)) or through the server 600

(via the links 625(a) and 605) to retrieve the images/videos related to the event from the first portion of the buffer memory 660 and store the retrieved images/videos as an event file in the second portion of the buffer memory 670. The memory device 610 may later send the event file to the server 600 for long term storage and further view. The images/videos recorded in the first portion of the memory device 660 are overwritten once the first portion is full.

Alternatively, the memory device 610 only comprises a single memory space, wherein the continuously stored images/videos and the event files created and stored for further inspection are distinguishable because the two are arranged to have different file name systems, electronic formats or information tags.

In another embodiment, as illustrated in Figure 7, the buffer memory of a memory device 710 comprises at least a first portion 760, a second portion 770 and a third portion 780. The images/videos of a premise captured by the image capturing devices 720 are sent to the memory device 710 via a network link 715, which stores the received images/videos into the first portion 760. Upon being triggered or instructed either directly by an event detection module 740 via communication link 725(b) or indirectly through a server 700, the memory device 710 retrieves images/videos related to the detected event of interest from the first portion 760, saves the retrieved images/videos as an event file in the second portion 770, and further saves at least one of the retrieved images in the third portion 780.

Alternatively, upon being triggered or instructed by the event detection module 740, the memory device 710 stores the images/videos received thereafter ("post-recording") directly into the second portion 770 until the completion of the event, retrieves from the first portion 760 the images/video clips captured in a preset time duration before the occurrence of the event ("pre-recording"), and assembles the pre-recording and post-recording as an event file. The event file therefore captures and stores the scenes of the event from the beginning (e.g., the scenes captured in the "pre-recording") till the end (e.g., the scenes captured in the "post-recording").

This assembly of the “pre-recording” and “post-recording” effectively addresses the technical problem in the prior art where the scenes before an event happened are often not captured. This is because, when a premise management system or a person in charge, upon detecting an event of interest, requests the monitoring system to commence capturing images/videos of the event, the event has already happened. For example, during the lowering of a barrier arm, a vehicle knocks into the barrier arm. A sensor installed on the barrier arm is then triggered to send an alarm to a vehicle park management system. The system, upon receiving the barrier alarm, triggers DVR/NVR to start recording and storing a video clip. However, the generated video clip will only be able to capture the scenes occurred after the sensor was triggered. Nothing occurred before the triggering of the sensor will be included in the video clip. This compromises the usefulness of the video clip since it does not show a complete picture on how the vehicle knocked into the barrier. In the above embodiments, a first portion 760 of a buffer memory is utilized to continuously store the images captured as well as to overwrite the earlier images with the new ones once the first portion is full (e.g., the memory space can accommodate up to three (3) mins recording). Once an event of interest occurs (e.g., vehicle tailgating), the invention performs post-recording, retrieves the corresponding pre-recording (e.g., 30 seconds before the triggering of the sensor) from the first portion 760, and assembles the pre-recording and the post-recording together into the second portion 770. The event file, consisting of both pre-recording and post-recording, is able to let the viewer understand the entire event, from the beginning till the end.

In some embodiments, the event file may be stored in the second portion 770 and later transferred to the server 700 for storage once the second portion 770 is full. Alternatively, the event file, upon generation, is directly transferred to the server 700 for storage. In some embodiments, at least one image of the event (e.g., extracted either from the post-recording or the pre-recording) is stored in the third portion 780. The image stored in the third portion 780 may be transferred to the server 700 for storage once the third portion 780 is full. In some embodiments, the at least one image saved in the third portion 780 of the buffer

memory is taken when the barrier of the vehicle park gantry is raised to allow a vehicle to pass. Such image is known as “transaction image”, and kept in high resolution format. Such image can be useful to the management of the vehicle park or the relevant customer.

In some embodiments, the first portion 760 may be a random-access memory (RAM). In some embodiments, the second portion 770 and the third portion 780 may be hard disks. In some embodiments, the images stored in the third portion 780 may be kept in high resolution file formats (e.g., Portable Network Graphics (PNG) format, 1280 pixels x 720 pixels, bit depth 32, file size 1.31MB; Joint Photographic Experts Group (JPEG) format, 1280 pixels x 720 pixels, bit depth 24, file size 246KB), and the event files stored in the second portion 770 may also be kept in high resolution formats (e.g., for the video event files: 120 MB for a one-minute Motion Picture Experts Group 4 (MPEG4) video; 20 MB for a 10-second MP4 video; 3~6 MB for a one-minute H.264 file). In some embodiments, the present invention is further combined with another surveillance system that continuously records and stores the scene of a premise in low resolution format (e.g., Common Intermediate Format (CIF) format, 352 pixels x 240 pixels).

In some embodiments, the server 700 sends an electronic instruction (or command) to the memory device 710 (NVR/DVR) to transfer the files stored in the buffer memory of the memory device 710 (e.g., the event files stored in the second portion 770; the images stored in the third portion 780) to the designated locations in the server 700. In some embodiments, the files stored in the buffer memory of the memory device 710 (e.g., the event files stored in the second portion 770; the images stored in the third portion 780) may be stored in a network Hard Disk Drive (HDD) or a network-attached storage (NAS) device or any other type of computer data storage device connected to a computer network.

In some embodiments, the first 760, second 770 and third 780 portions of the buffer memory and the memory device are arranged in data communication via data networks or links 735 and 745. In some embodiments, the first 760, second

770 and third 780 portions of the buffer memory and the memory device are integrated as a single apparatus.

The embodiment illustrated in Figure 7 provides additional advantages and convenience to the user of the system, since an event of interest is linked to at least an image (stored first in the third portion 780 and possibly later in the server 700) and an event file capturing the scene of the event in its entirety (stored first in the second portion 770 and later in the server 700). For simple purposes that only require the inspection of image (e.g., transaction image), the user just needs to retrieve the image file for view. For serious matters that require the inspection of the entire event, the user can then retrieve and view the event file.

In another embodiment of the invention, images are captured by the image capturing device following a timeline 801 (from T0 to Tn). At least an image of a premise is captured at each time point (e.g., T0, T1, T2, T3 and so on). All captured images are sent to the memory device (a video recorder) for storage into the buffer memory or the first portion thereof. When an event of interest (e.g., vehicle moving in or out of a parking slot; vehicle tailgating; mechanical failure of the gantry system; vehicle moving into a particular location that is prone to accident) is detected at the time point T5 by an event detection module, the memory device will then receive an electronic instruction to store an event file 802 comprising at least an image taken before the event (e.g., the images at T3 & T4), an image taken at the time the event (e.g., the image at T5) and an image after the event (e.g., the images at T6, T7 & T8) in the buffer memory or the second portion thereof. It is to be appreciated that the image taken before the event, at the time the event occurred, and after the event are retrieved from the images already stored in the buffer memory or the first portion thereof. As appreciated by a person skilled in the art, the number of images to be included in the event file can be adjusted according to considerations such as the nature of the events, the conditions of the premise and the specific needs of the premise management. The event file can be formatted into an image file or a video file. Images taken at other time points such as T0, T1, T2 and T9 are stored by the

memory device in the buffer memory or the first portion thereof, and promptly overwritten once the buffer memory or the first portion thereof is full.

The above is a description of embodiment(s) of an apparatus, system for managing a premise, particularly a vehicle park. It is to be further appreciated that features from one or more embodiments as described may be combined to form further embodiments without departing from the scope of the present invention.

Claims:

1. A system for event detection at a premise comprising:

an image capturing device operable to capture at least one image of the premise at every predetermined time interval;

a memory device comprising a buffer memory arranged in data communication with the image capturing device, wherein the memory device is configured for continuously receiving the at least one image captured by the image capturing device;

a server arranged in data communication with the memory device;

a gantry system arranged in data communication with the server, wherein the gantry system is equipped with at least one sensor, wherein the at least one sensor projects a sensor curtain that can differentiate that there are a plurality of vehicles passing through the gantry system within a fixed period of time;

wherein the server, upon receipt of an error message from the gantry system triggered by an event, sends an electronic instruction to the memory device to store in the buffer memory an event file comprising at least an image before the event, an image at the time the event occurs and an image after the event.

2. A system according to claim 1, wherein the image capturing device is a video camera.

3. A system according to claim 1, wherein the memory device is a video recorder.

4. A system according to claim 1, wherein the event file is a video.

5. A system according to claim 1, wherein the premise is a vehicle park.

6. A system according to claim 1, wherein the gantry system is equipped with a safety sensor that prevents a barrier arm of the gantry system from falling on a vehicle.

7. A system according to claim 6, wherein the safety sensor is a photodetector sensor, a laser sensor or a magnetic sensor.

8. A system according to claim 1, wherein the at least one sensor is positioned to detect if only one vehicle passes through the gantry system at a time.

9. A system according to claim 1, wherein the event file is tagged with at least one identification information.

10. A system according to claim 9, wherein the identification information is selected from the group comprising vehicle plate number, vehicle IU number, vehicle colour, vehicle model, exit lane number, entrance lane number, gantry number, date, time, premise name, premise address, vehicle park name and vehicle park address.

11. A system according to claim 1, wherein the event file is transmitted by the memory device to the server for storage.

12. A system according to claim 11, wherein the server is operable to generate an electronic report based on the event file.

13. A system according to claim 1, wherein the error message is triggered when a barrier arm of the gantry system is not in a predetermined position.

14. A system according to claim 1, wherein the error message is triggered when a manual override is applied to raise a barrier arm of the gantry system.

15. A system according to claim 1, wherein the buffer memory is a storage medium selected from the group comprising random-access memory (RAM), a hard disk, a flash memory, a compact flash (CF) card, a secure digital (SD) card, a smart media (SM) card, a multimedia card (MMC) and a memory stick.

16. A system for event detection at a premise comprising:

an image capturing device operable to capture at least one image of the premise at every predetermined time interval;

a memory device comprising a buffer memory arranged in data communication with the image capturing device, wherein the memory device is configured for continuously receiving the at least one image captured by the image capturing device;

an event detection module operable to detect an event and send an electronic instruction to the memory device to store in the buffer memory an event file comprising at least an image before the event, an image at the time the event occurs and an image after the event,

wherein the event detection module is a gantry system with at least one sensor, wherein the at least one sensor projects a sensor curtain that can differentiate that there are a plurality of vehicles passing through the gantry system within a fixed period of time.

17. A system according to claim 16, wherein the image capturing device is a video camera.

18. A system according to claim 16, wherein the memory device is a video recorder.

19. A system according to claim 16, wherein the event file is a video.

20. A system according to claim 16, wherein the premise is a vehicle park.

21. A system according to claim 16, wherein the event is a vehicle moving into or out of a parking slot.

22. A system according to claim 16, wherein the event is a vehicle moving through a particular location of the vehicle park.

23. A system according to claim 22, wherein the particular location of the vehicle park is prone to accident.

24. A system according to claim 22, wherein the particular location of the vehicle park is an entrance or an exit of the vehicle park.

25. A system according to claim 16, wherein the event file is tagged with at least one identification information.

26. A system according to claim 25, wherein the identification information is selected from the group comprising vehicle plate number, vehicle IU number, vehicle colour, vehicle model, exit lane number, entrance lane number, gantry number, date, time, premise name, premise address, vehicle park name and vehicle park address.

27. A system according to claim 16, wherein the event file is transmitted by the memory device to a server for storage.

28. A system according to claim 27, wherein the server is operable to generate a report based on the event file.

29. A system according to claim 16, wherein the buffer memory is a storage medium selected from the group comprising random-access memory (RAM), a hard disk, a flash memory, a compact flash (CF) card, a secure digital (SD) card, a smart media (SM) card, a multimedia card (MMC), or a memory stick.

30. A system according to claim 16, wherein the event detection module is integrated with the memory device.

36. A method for event detection at a vehicle park comprising:

capturing at least one image of the vehicle park by an image capturing device at every predetermined time interval;

continuously receiving at least one image captured by the image capturing device by a memory device comprising a buffer memory arranged in data communication with the image capturing device;

detecting an error by a gantry system of the vehicle park, wherein the gantry system is equipped with at least one sensor, wherein the at least one sensor projects a sensor curtain that can differentiate that there are a plurality of vehicles passing through the gantry system within a fixed period of time;

sending an error message to a server by the gantry system;

sending an electronic instruction to the memory device by the server to store in the buffer memory an event file comprising at least an image before the event, an image at the time the event occurs and an image after the event.

37. A method according to claim 36, further comprising the step of transmitting the event file by the memory device to a server for long term storage.

38. A method according to claim 37, further comprising the step of naming or tagging the event file with at least one identification information, wherein the identification information is selected from the group comprising vehicle plate number, vehicle IU number, vehicle colour, vehicle model, exit lane number, entrance lane number, gantry number, date, time, premise name, premise address, vehicle park name and vehicle park address.

39. A method according to claim 38, further comprising the step of generating a report based on the event file.