ONE-TO-MANY-SURFACE PARKING LOT MANAGEMENT SYSTEM USING OMNIDIRECTIONAL CAMERA AND MANAGEMENT METHOD THEREOF

TECHNICAL FIELD

[01] The present invention relates to a one-to-many-surface parking lot management system using an omnidirectional camera and a management method thereof, and more specifically, to a parking lot management system and a management method thereof, which can detect a vehicle parked on a plurality of parking surfaces using an omnidirectional camera and perform a security function at the same time.

BACKGROUND ART

[02] Although large buildings such as department stores, large shopping centers, hospitals and the like with a big floating population have a spacious parking facility providing a large number of parking spaces, the parking facilities are running short greatly as the number of vehicles abruptly increases recently.

[03] Particularly, since a lot of people gather on weekends or holidays, the parking spaces are excessively insufficient in many cases, and since drivers move around in a large parking facility to park their vehicles, there is a problem of wasting time and money.

[04] Accordingly, parking guidance systems capable of providing a driver with convenience of parking by displaying whether or not parking spaces sufficiently remain using a sensor for sensing whether or not a vehicle is parked on a parking surface are developed and widely commercialized.

[05] A general parking guidance system of the prior art uses a method of using a sensor installed on each parking surface to sense whether or not a vehicle is parked.

[06] However, there is a problem in that the sensor used in the conventional parking guidance system is comparatively expensive and a lot of cost and efforts are required to maintain and manage the sensor. Such a sensor recognizes an object other than the vehicles, such as a person or a cart, as a vehicle by mistake in many cases, and inconveniences are invited due to sensing errors.

[07] In addition, when a CCTV is installed in a parking facility to perform a security function, there is a problem in that cost of the facility is high since a camera equipment, wires and a management PC should be separately installed, and maintenance and management thereof are difficult since the facility is complicated.

[08] Accordingly, required is development of a system which can further efficiently detect a vehicle and guide parking of a vehicle and, at the same time, provide a security function for preventing crimes or the like.

DISCLOSURE OF INVENTION

TECHNICAL PROBLEM

[09] Therefore, the present invention has been made in view of the above problems, and it is an object of the present invention to provide a parking lot management system and a management method thereof, which can detect a vehicle parked on a plurality of parking surfaces using an omnidirectional camera and perform a security function at the same time.

[10] Specifically, an object of the present invention is to provide a user with a parking lot management system, which does not need to install a large number of cameras and separately install a CCTV since about twelve parking surfaces can be photographed by one omnidirectional camera and thus may economically and easily maintain and manage a parking lot and provide a security function using photographed images.

[11] In addition, another object of the present invention is to provide a user with a parking lot management system, which can effectively perform detection of a vehicle and prevent a false detection by installing a sensor on a parking surface of a position where photographing using an omnidirectional camera is impossible due to the structure of a parking lot or on a parking surface of a position where detection of a vehicle is difficult due to excessively high or low luminance.

[12] In addition, another object of the present invention is to provide a user with a parking lot management system, which simplify a wiring facility, save installation cost, and considerably reduce the construction period by operating the sensor in association with the omnidirectional camera.

[13] Meanwhile, the technical problems to be solved in the present invention are not limited to those mentioned above, and unmentioned other technical problems can be clearly understood by those skilled in the art from the following descriptions.

TECHNICAL SOLUTION

[14] To accomplish the above objects, according to one aspect of the present invention, there is provided a one-to-many-surface parking lot management system for managing a parking lot having a plurality of parking surfaces arranged configuring a plurality of columns, the system including: an omnidirectional camera installed on a ceiling of the parking lot between two adjacent columns among the plurality of columns and provided with a fisheye lens to photograph a surveillance image of all directions; a cable connected to the omnidirectional camera to transmit the surveillance image; and a management server connected to the cable to receive the surveillance image, in which the management server includes: a vehicle sensing module for determining whether or not a vehicle is parked on the plurality of parking surfaces; and a security module provided

with a memory for storing the surveillance image, and some of parking surfaces arranged in a first column and some of parking surfaces arranged in a second column are photographed in the surveillance image, and the first column and the second column are two adjacent columns where the omnidirectional camera is installed.

[15] In addition, five to seven parking surfaces among the parking surfaces arranged in the first column are photographed in the surveillance image, and five to seven parking surfaces among the parking surfaces arranged in the second column are photographed in the surveillance image.

[16] In addition, the vehicle sensing module may include: an area setting unit for setting an area of the parking surfaces photographed in the surveillance image; a feature extraction unit for extracting a feature vector from the area of the parking surfaces set by the area setting unit; and a detection unit for determining whether or not a vehicle is parked in the area of the parking surfaces using the feature vector.

[17] In addition, the one-to-many-surface parking lot management system may further include a sensing sensor installed to be adjacent to a first parking surface, which is part of the plurality of parking surfaces, to senses a vehicle positioned on the first parking surface and create a sensing signal corresponding to a result of the sensing, and the cable is connected to the sensing sensor associated with the

omnidirectional camera and transmits the sensing signal to the management server.

[18] In addition, the first parking surface may include a second parking surface arranged at a photographing blind spot of the omnidirectional camera and a third parking surface arranged at a position where the vehicle sensing module may not determine whether or not a vehicle is parked according to changes of environmental factors including luminance.

[19] In addition, the vehicle sensing module may determine whether or not a vehicle is parked on the first parking surface using the sensing signal.

[20] In addition, when the vehicle sensing module can determine whether or not a vehicle is parked on the third parking surface using the surveillance image, the vehicle sensing module may determine whether or not a vehicle is parked on the third parking surface by additionally using the surveillance image.

[21] In addition, the one-to-many-surface parking lot management system may further include a full-empty parking indicator for outputting a preset indication related to whether or not a vehicle is parked on the plurality of parking surfaces, and the management server may control output of the full-empty parking indicator according to the determination of the vehicle sensing module.

[22] According to another aspect of the present invention, there is provided a one-to-many-surface parking lot management

method for managing a management system which manages a parking lot having a plurality of parking surfaces arranged configuring a plurality of columns, the method including: a first step of photographing a surveillance image of all directions, by an omnidirectional camera provided with a fisheye lens; a second step of transmitting the surveillance image through a cable connected to the omnidirectional camera; a third step of receiving the surveillance image, by a management server connected to the cable; and a fourth step of determining whether or not a vehicle is parked on a plurality of parking surfaces using the surveillance image, by a vehicle sensing module of the management server, in which the omnidirectional camera is installed on a ceiling of the parking lot between two adjacent columns among the plurality of columns, some of parking surfaces arranged in a first column and some of parking surfaces arranged in a second column are photographed in the surveillance image, the first column and the second column are two adjacent columns where the omnidirectional camera is installed, and the management server further includes a security module provided with a memory for storing the surveillance image.

ADVANTAGEOUS EFFECTS

[23] Therefore, the present invention has been made in view of the above problems, and it is an object of the present invention to provide a parking lot management system and a

management method thereof, which can detect a vehicle parked on a plurality of parking surfaces using an omnidirectional camera and perform a security function at the same time.

[24] Specifically, the present invention provides a user with a parking lot management system, which does not need to install a large number of cameras and separately install CCTVs since about twelve parking surfaces can be photographed by one omnidirectional dual camera and thus may economically and easily maintain and manage a parking lot and provide a security function using photographed images.

[25] In addition, the present invention provides a user with a parking lot management system, which can effectively perform detection of a vehicle and prevent a false detection by installing a sensor on a parking surface of a position where photographing using an omnidirectional camera is impossible due to the structure of a parking lot or on a parking surface of a position where detection of a vehicle is difficult due to excessively high or low luminance.

[26] In addition, the present invention provides a user with a parking lot management system, which simplify a wiring facility, save installation cost, and considerably reduce the construction period by operating the sensor in association with the omnidirectional camera.

[27] Meanwhile, the effects that can be obtained in the present invention are not limited to those mentioned above, and

unmentioned other effects can be clearly understood by those skilled in the art from the following descriptions.

BRIEF DESCRIPTION OF THE DRAWINGS

[28] Since the drawings accompanied in the specification of the present invention illustrate a preferred embodiment of the present invention and give a better understanding of the spirits of the present invention together with detailed descriptions of the present invention, the present invention should not be interpreted as being limited to the context described in the drawings.

[29] FIGS. 1 and 2 show an example of a parking lot in which a one-to-many-surface parking lot management system of the present invention is implemented.

[30] FIGS. 3 and 4 show an embodiment of surveillance images photographed by an omnidirectional camera, which can be applied to the present invention.

[31] FIG. 5 shows an example of a block diagram of a one-to-many-surface parking lot management system of the present invention.

[32] FIG. 6 is a flowchart illustrating a method of managing a parking lot related to an example of the present invention.

[33] FIGS. 7 to 9 show an embodiment of a vehicle detection process that can be applied to the present invention.

DESCRIPTION OF SYMBOLS

10: Omnidirectional camera	15: Sensing sensor
20: Cable	30: Parking surface
40: Vehicle	100: Parking lot
200: Management server	210: Vehicle sensing module
212: Area setting unit	214: Feature extraction unit
216: Detection unit	230: Security module
232: Memory	

BEST MODE FOR CARRYING OUT THE INVENTION

[34] In a one-to-many-surface parking lot management system according to the present invention, an omnidirectional camera installed on the ceiling of a parking lot between two adjacent columns among a plurality of columns photographs a surveillance image of all directions using a fisheye lens, and the surveillance image is transmitted to a management server through a cable connected to the omnidirectional camera. Some of the parking surfaces arranged in a first column and some of the parking surfaces arranged in a second column are photographed in the surveillance image.

[35] The management server is configured of a vehicle sensing module and a security module. The vehicle sensing module determines whether or not a vehicle is parked on a plurality of

parking surfaces using the surveillance image, and the security module stores the surveillance image in memory.

[36] Hereinafter, a preferred embodiment of the present invention will be described with reference to the drawings. In addition, the embodiment described hereinafter does not unduly limit the scope of the present invention disclosed in the claims, and the entire configuration described in this embodiment cannot be said as being indispensable as a means for solving the problems of the present invention.

[37] Since a conventional parking lot management system is configured to connect a sensing sensor to a controller or a server to be separate from a detection camera, it is disadvantageous from the aspect of cost and efficiency.

[38] The present invention proposes a parking lot management system and a control method thereof which can simultaneously perform vehicle detection to guide parking and a security function by configuring the system to associate an omnidirectional camera with a sensing sensor.

[39] <One-to-many-surface parking lot management system>

[40] Hereinafter, a one-to-many-surface parking lot management system proposed by the present invention will be described with reference to the drawings.

[41] FIGS. 1 and 2 show an example of a parking lot in which a one-to-many-surface parking lot management system of the present invention is implemented.

[42] Referring to FIG. 1, a one-to-many-surface parking lot management system of the present invention can be applied to a large indoor parking lot 100 in which a plurality of parking surfaces 30 is arranged configuring a plurality of columns. FIG. 1 shows part of a parking lot 100 to which the present invention is applied, and each parking surface 30 provides a space for parking one vehicle 40.

[43] An omnidirectional camera 10 is installed on a raceway on the ceiling of the parking lot 100, between two adjacent columns among a plurality of columns configured by a plurality of parking surfaces 30. That is, if it is assumed that one of the plurality of columns is a first column and a column adjacent to the first column is a second column, the omnidirectional camera 10 is installed between the first column and the second column.

[44] The omnidirectional camera 10 is implemented using a camera having a fisheye lens. If a fisheye lens having a wide angle of view is used, an image of an omnidirectional (360˚) area around the omnidirectional camera 10 can be photographed.

[45] As shown in FIG. 1, the omnidirectional camera 10 photographs an image of an area around the omnidirectional camera 10. The area photographed by the omnidirectional camera 10 includes a vehicle detection area 12 and a security function area 14 of the parking lot 100.

[46] The vehicle detection area 12 includes parking surfaces 30 around a column where the omnidirectional camera 10

is installed, and one omnidirectional camera 10 may photograph a vehicle detection area 12 including approximately twelve parking surfaces 30. For example, the vehicle detection area 12 may include five to seven areas of the parking surfaces 30 arranged in each of the first column and the second column.

[47] A surveillance image photographed by the omnidirectional camera 10 includes the vehicle detection area 12, and images photographing the vehicle detection area 12 are as shown in FIGS. 3 and 4.

[48] FIGS. 3 and 4 show an embodiment of surveillance images photographed by an omnidirectional camera, which can be applied to the present invention. FIG. 3 shows a surveillance image photographed by the omnidirectional camera 10, and FIG. 4 shows an image converted from the image shown in FIG. 3.

[49] The surveillance image photographed by the omnidirectional camera 10 may be converted into an image as shown in FIG. 4 by removing distortions of each area by adjusting a distance ratio according to long distance or short distance. Forward mapping through application of a correction factor and interpolation accompanied thereto can be used as a method of correcting the distorted image information, and inverse mapping, which is a method of assuming a corrected image in advance and looking for points of a distorted image matching to the points of the corrected image, also can be used.

[50] Referring to FIG. 1 again, an appropriate number of omnidirectional cameras 10 are installed to cover all the plurality of parking surfaces 300 arranged in the parking lot 100. The plurality of omnidirectional cameras 10 installed in the parking lot 100 can be connected to the management server 200 through a cable 20.

[51] Meanwhile, referring to FIG. 2, a sensing sensor 15 can be separately installed on a parking surface of a position where it is difficult for the omnidirectional camera 10 to sense a vehicle 40, among the parking surfaces 30 of the parking lot 100. Here, an ultrasonic sensor, a laser sensor, a photo sensor or the like can be used as the sensing sensor 15.

[52] The sensing sensor 15 may be installed on a parking surface positioned at a photographing blind spot of the omnidirectional camera 10. As shown in FIG. 2, a parking surface 32 positioned beside a pillar is difficult to photograph by the omnidirectional camera 10 due to the structural features of the parking lot 100, and a sensing sensor 15 is installed on the parking surface 32 to easily detect a vehicle 40.

[53] In addition, it could be required to install a sensing sensor 15 on a parking surface arranged at a position where whether or not a vehicle is parked could not be determined according to changes of environmental factors including luminance. If the luminance increases to be higher than a predetermined level, although photographing is possible by the omnidirectional

camera 10, detection of a vehicle 40 could be difficult. Contrarily, in a parking surface at a position where the luminance is too low, it is possible that detection of a vehicle 40 cannot be properly accomplished. A vehicle can be easily detected by separately installing a sensing sensor 15 on a parking surface at a position where detection of a vehicle 40 using a surveillance image could be difficult although photographing is possible by the omnidirectional camera 10.

[54] The sensing sensor 15 may recognize an object positioned on a parking surface where the sensing sensor 15 is installed and creates a sensing signal according to the recognition.

[55] The sensing sensor 15 is connected to the omnidirectional camera 10 and operates in association with the omnidirectional camera 10. Since the sensing sensor 15 and the omnidirectional camera 10 are connected through one cable 20, additional wiring is not needed, and thus the facility is simplified, and a unified process can be performed.

[56] Meanwhile, FIG. 5 shows an example of a block diagram of a one-to-many-surface parking lot management system of the present invention.

[57] Referring to FIG. 5, an omnidirectional camera 10 installed in a parking lot 100 is connected to a management server 200 through a cable 20. The management server 200 receives information on a surveillance image photographed by the

omnidirectional camera 10 and a sensing signal created by a sensing sensor 15.

[58] The management server 200 is configured of a vehicle sensing module 210 for determining whether or not a vehicle 40 is parked on a plurality of parking surfaces 30 of the parking lot 100 and a security module 230 provided with a memory 232 for storing the surveillance image. In addition, the management server 200 may be driven in association with an emergency bell facility and an illumination control facility of the parking lot 100.

[59] The vehicle sensing module 210 is configured of an area setting unit 212, a feature extraction unit 213 and a detection unit 214.

[60] The area setting unit 212 sets an area of the parking surfaces 30, which is an area where a vehicle 40 is parked, within a surveillance image photographed by the omnidirectional camera 10. The feature extraction unit 214 extracts a feature vector from the area of the parking surfaces 30 set by the area setting unit 212, and the detection unit 216 determines whether or not a vehicle 40 is parked in the area of the parking surfaces using the feature vector extracted by the feature extraction unit 214.

[61] The security module 230 is provided with a memory 232 for storing the surveillance image, and the surveillance image stored in the memory 232 may be set to be accessible when a

problem related to security occurs in a parking lot to which the present invention is applied.

[62] The memory 232 provided in the security module 230 may include at least one type of storage media among a flash memory type medium, a hard disk type medium, a multimedia card micro type medium, a card type memory (e.g., SD or XD memory or the like), a Random Access Memory (RAM), a Static Random Access Memory (SRAM), a Read-Only Memory (ROM), an Electrically Erasable Programmable Read-Only Memory (EEPROM), a Programmable Read-Only Memory (PROM), a magnetic memory, a magnetic disk, and an optical disk.

[63] In addition, the management server 200 may further include a display unit, a sound output module, a warning unit, a communication unit, an interface unit and the like.

[64] The display unit may output the surveillance image stored in the memory 232 or an image transmitted or received through the communication unit and may display a related user interface (UI) or graphic user interface (GUI).

[65] The display unit may include at least one of a Liquid Crystal Display (LCD), a Thin Film Transistor-Liquid Crystal Display (TFT LCD), an Organic Light-Emitting Diode (OLED), a Flexible Display and a 3D Display.

[66] The sound output module may output an audio data received from the communication unit or stored in the memory. The sound output module also outputs a sound signal related to a

function (e.g., confirming full of the parking lot or the like) performed by the management server 200. Such a sound output module may include a receiver, a speaker, a buzzer or the like.

[67] The warning unit outputs a signal for informing generation of an event of the management server 200. The event generated by the management server 200 includes, for example, a full or empty state of the parking surfaces, occurrence of an accident in a controlled area, occurrence of a crime and the like.

[68] The warning unit may output information of other forms, such as a warning guidance document or the like, other than audio signals or video signals, and, in this case, a printer for outputting the warning guidance document may be connected.

[69] The communication unit may include one or more modules which make communication possible between the management server 200 and a wired or wireless communication system or between the management server 200 and a network where the management server 200 is located.

[70] Techniques of the wireless Internet used in the communication unit may include Wireless LAN (WLAN) (Wi-Fi), Wireless broadband (Wibro), World Interoperability for Microwave Access (Wimax), Wideband Code Division Multiple Access (WCDMA), High Speed Downlink Packet Access (HSDPA), Long Term Evolution (LTE) and the like.

[71] The interface unit functions as a passage to all external devices connected to the management server 200. The

interface unit receives data from the external devices, receives and transfers power to each constitutional components in the management server 200, or transmits data internal to the management server 200 to the external devices.

[72] For example, the interface unit may include a port for connecting the surveillance image stored in the memory 232 to outside, an external recharger port, a wired or wireless data port, a memory card port, a port for connecting a device provided with an identification module, an audio input and output (I/O) port, a video input and output (I/O) port, and the like.

[73] Meanwhile, a full-empty parking indicator (not shown) for displaying whether or not vehicles 40 are parked on a plurality of parking surfaces 30 can be installed in a parking lot 100 to which the present invention is applied. The full-empty parking indicator may be installed to be integrated with or separate from the omnidirectional camera 10.

[74] The full-empty parking indicator outputs an indication for easily informing drivers entering the parking lot 100 of whether or not there is an available parking space. The indication may include a visual output related to a preset color or an auditory output for providing a voice related to whether or not the parking lot is full.

[75] At this point, the management server 200 may control output of the full-empty parking indicator according to determination of the vehicle sensing module 210 on the parking

surfaces 30. For example, if it is determined that vehicles 40 are parked on all the parking surfaces 30, the full-empty parking indicator may output an indication of ‘Parking Space Full’, and if it is determined that there are available parking surfaces 30 for parking vehicles 40, the full-empty parking indicator may output an indication of ‘Parking Space Available’. In addition, the full-empty parking indicator may be configured to individually indicate whether or not a vehicle 40 is parked on each parking surface 30.

[76] <One-to-many-surface parking lot management method>

[77] Hereinafter, a control method of the one-to-many-surface parking lot management system configured as described above will be described in detail.

[78] FIG. 6 is a flowchart illustrating a method of managing a parking lot related to an example of the present invention.

[79] Referring to FIG. 6, first, an omnidirectional camera 10 provided with a fisheye lens photographs a surveillance image of all directions (step S10), and a sensing sensor 15 installed to be adjacent to a first parking surface, which is part of a plurality of parking surfaces 30, senses a vehicle 40 positioned on the first parking surface and creates a sensing signal corresponding to a result of the sensing (step S12).

[80] Subsequently, an input data including the surveillance image and the sensing signal is transmitted through a cable 20

connected to the omnidirectional camera 10 and the sensing sensor 15 (step S20), and a management server 200 connected to the cable 20 receives the input data (step S30).

[81] As described above, since the omnidirectional camera 10 is connected to one cable 20, parking guidance and security function can be provided at the same time at a low cost of facility.

[82] Subsequently, a vehicle sensing module 210 of the management server 200 determines whether or not a vehicle 40 is parked on a plurality of parking surfaces 30 using the input data, and a security module 230 of the management server 200 stores the surveillance image included in the input data in a memory 232.

[83] Specifically, if it is assumed that a parking surface which is difficult to be determined by a surveillance image among a plurality of parking surfaces 30 is a first parking surface, the vehicle sensing module 210 may determine whether or not a vehicle 40 is parked on the first parking surface using the sensing signal among the input data and determine whether or not a vehicle 40 is parked on a parking surface other than the first parking surface using the surveillance image among the input data.

[84] Since a vehicle 40 parked on the first parking surface is difficult to sense by the omnidirectional camera 10, whether or not a vehicle 40 is parked on the first parking surface is determined by a sensing signal created by the sensing sensor 15.

[85] However, if the vehicle sensing module 210 can determine whether or not a vehicle is parked on part of the first parking surface using the surveillance image, whether or not the vehicle 40 is parked can be determined by additionally using the surveillance image.

[86] For example, if detection of a vehicle by a surveillance image is allowed according to changes of luminance, the vehicle sensing module 210 may determine whether or not a vehicle is parked by using both the surveillance image photographed by the omnidirectional camera 10 and the sensing signal created by the sensing sensor 15.

[87] At this point, although it does not make a problem if the determination according to the surveillance image corresponds to the determination of the sensing signal, if the determination according to the surveillance image does not correspond to the determination of the sensing signal, sensing a vehicle 40 can be accomplished more correctly by receiving again the surveillance image and the sensing signal after a predetermined time is elapsed and determining again whether or not a vehicle is parked.

[88] In addition, unlike the process shown in FIG. 6, the vehicle sensing module 210 may determine whether or not a vehicle 40 is parked on a plurality of parking surfaces 30 using the surveillance image basically included in the input data, and if it is difficult to determine whether or not a vehicle 40 is parked using only the surveillance image, the vehicle sensing

module 210 uses the sensing signal created by the sensing sensor 15.

[89] Specifically, the vehicle sensing module 210 determines whether not a vehicle 40 is parked on a plurality of parking surfaces 30 first using the surveillance image included in the input data. If detection of a vehicle is not smoothly performed on a specific parking surface due to degradation of the surveillance image or an effect of surrounding environments, detection of a vehicle on the parking surface can be performed again by additionally using the sensing signal of the input data.

[90] FIGS. 7 to 9 show an embodiment of a vehicle detection process that can be applied to the present invention.

[91] As shown in FIG. 7, an area of the parking surfaces 30, which is an area where a vehicle 40 is parked, is set within the surveillance image by the area setting unit 212. A vehicle 40 parked in the area of the parking surfaces set by the area setting unit 212 can be photographed as shown in FIG. 8, and a feature vector is extracted as shown in FIG. 9 to determine whether or not it corresponds to a vehicle 40.

[92] Specifically, the feature vector can be extracted from the surveillance images using a vehicle recognition algorithm for recognizing a vehicle 40. Any one of the Scale-Invariant Feature Transform (SIFT), Speeded Up Robust Features (SURF), Histogram of Oriented Gradients (HOG), Haar-like features and Gabor filter can be used as the vehicle recognition algorithm.

[93] Here, the SIFT algorithm is a representative algorithm for extracting a feature vector of an image and has a characteristic of being invariant to image rotation, scaling, movement, partial illumination changes and projective transform. The SIFT algorithm may extract attributes such as a position, a scale and a direction of a feature considering the characteristic of a local image.

[94] That is, as a first step, the SIFT algorithm searches for extrema in a scale space created through a Difference-Of-Gaussian (DOG) function and selects sample points (or candidate pixels) (Scale-space extrema detection).

[95] As a second step, the SIFT algorithm selects keypoints based on stability values (Keypoint localization).

[96] As a third step, the SIFT algorithm allocates one or more directions to each keypoint (Orientation assignment).

[97] As a final step, the SIFT algorithm creates a keypoint descriptor using local image gradients (Keypoint descriptor).

[98] Details of the SIFT algorithm are described in the paper entitled "Distinctive image features from scale-invariant keypoints".

[99] In addition, the SURF algorithm is an algorithm searching for features invariant to environmental changes from several images considering the environmental changes such as magnitude, illumination, time point and the like, which is an algorithm showing a performance comparable to that of the SIFT

algorithm which is generally known to be superior and, at the same time, improving speed significantly.

[100] Details of the SURF algorithm are described in the paper entitled "Robust Interest Point Detection and Descriptor".

[101] In addition, the HOG algorithm is based on that the appearance or shape of a specific object in an image can be determined by a gradient magnitude or distribution of edge directions. The HOG algorithm may recognize a specific object by partitioning an image into a plurality of areas referred to as a cell and creating a histogram of gradients or edge directions for each cell.

[102] Details of the HOG algorithm are described in the paper entitled "Histograms of oriented gradients for human detection".

[103] In addition, the Haar-like features algorithm may recognize a specific object using a prototype expressing feature information of edges and a prototype expressing feature information lines. Details of the HOG algorithm are described in the paper entitled "An Extended Set of Haar-like Features for Rapid Object Detection".

[104] In addition, details of the Gabor filter algorithm are described in the paper entitled "Uncertainty relation for resolution in space, spatial frequency, and orientation optimized by two-dimensional visual cortical filters".

[105] The feature vector extracted by the vehicle recognition algorithm can be compared with previously stored learning data. Since the learning data includes feature vectors of a general vehicle image, it can be determined that whether or not an object photographed in an area of a parking surface of a surveillance image is a vehicle, and the vehicle can be recognized.

[106] The parking lot management system of the present invention described above may implement a parking guidance system at a cost equal to or lower than that of an ultrasonic facility, easily secure base data when an accident occurs, reduce malfunctions generated by a cart or a person, eliminate the need of constructing a separate CCTV, save cost by associating the system with an emergency bell or illumination control facility, improve convenience of customers by using a dual full-empty parking indicator, reduce a construction period by simplifying a wiring process and detect a vehicle on a hidden side.

[107] Meanwhile, the present invention can be implemented as a computer-readable code in a computer-readable recording medium. The computer-readable recording medium includes all kinds of recording devices for storing data that can be read by a computer system. Examples of the computer-readable recording medium are ROM, RAM, CD-ROM, a magnetic tape, a floppy disk, an optical data storage device and the like, and, in addition, a medium implemented in the form of a carrier wave (e.g., transmission

through the Internet) is also included. In addition, the computer-readable recording medium may be distributed in computer systems connected through a network, and a code that can be read by a computer in a distributed manner can be stored and executed therein. In addition, functional programs, codes and code segments for implementing the present invention can be easily inferred by programmers in the art.

[108] The apparatus and method having described so far may not be limited to the configurations and methods of the described embodiments, but the whole or parts of the embodiments may be selectively combined so as to implement various modifications.

[CLAIMS]

1. A one-to-many-surface parking lot management system for managing a parking lot having a plurality of parking surfaces arranged configuring a plurality of columns, the system comprising:

an omnidirectional camera installed on a ceiling of the parking lot between two adjacent columns among the plurality of columns and provided with a fisheye lens to photograph a surveillance image of all directions;

a sensing sensor associated with the omnidirectional camera and installed to be adjacent to a first parking surface, which is part of the plurality of parking surfaces, to sense a vehicle positioned on the first parking surface using ultrasonic waves and create a sensing signal corresponding to a result of the sensing;

a cable connected to the omnidirectional camera to transmit the surveillance image and connected to the sensing sensor to transmit the sensing signal;

a management server connected to the cable to receive the surveillance image and the sensing signal; and

a full-empty parking indicator, installed to unite with the omnidirectional camera, for outputting a preset indication related to whether or not a vehicle is parked on the plurality of parking surfaces,

wherein the management server further comprises:

a vehicle sensing module for determining whether or not a vehicle is parked on the plurality of parking surfaces;

a security module provided with a memory for storing the surveillance image; and

a display unit for outputting the surveillance image,

wherein the vehicle sensing module further includes:

an area setting unit for setting an area of the parking surfaces photographed in the surveillance image;

a feature extraction unit for extracting a feature vector from the area of the parking surfaces, set by the area setting unit, using a vehicle recognition algorithm; and

a detection unit for determining whether or not a vehicle is parked in the area of the parking surfaces using the feature vector,

wherein the management server controls output of the full-empty parking indicator according to the determination of the vehicle sensing module,

wherein some of parking surfaces arranged in a first column and some of parking surfaces arranged in a second column are photographed in the surveillance image, and the first column and the second column are two adjacent columns where the omnidirectional camera is installed,

wherein five to seven parking surfaces among the parking surfaces arranged in the first column are photographed in the surveillance image, and five to seven parking surfaces among the parking surfaces arranged in the second column are photographed in the surveillance image,

wherein the first parking surface includes a second parking surface arranged at a photographing blind spot of the

omnidirectional camera and a third parking surface arranged at a position where the vehicle sensing module may not determine whether or not a vehicle is parked according to changes of environmental factors including luminance,

wherein one of the followings such as SIFT (Scale-Invariant Feature Transform), SURF (Speeded Up Robust Features), HOG (Histogram of Oriented Gradients), Haar-like features and Gabor filters is used for the vehicle recognition algorithm,

wherein the vehicle sensing module determines whether or not a vehicle is parked on the first parking surface using the sensing signal and determines whether or not a vehicle is parked on any parking surfaces other than the first parking surface among the plurality of the parking surfaces using the surveillance image, and

wherein the vehicle sensing module determines whether or not a vehicle is parked on the third parking surface by additionally using the surveillance image, when the vehicle sensing module can determine whether or not a vehicle is parked on the third parking surface using the surveillance image, and wherein the vehicle sensing module determines again whether or not a vehicle is parked on the third parking surface using the surveillance image and the sensing signal transmitted after the lapse of a preset time, when the result of the determination on the third parking surface on the basis of the surveillance image is not identical with the one of the determination on the third parking surface on the basis of the sensing signal.