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(56) Related Art
US 2004/0068433 A1 (Chatterjee et al.) 08 April 2004
US 7688225 B1 (Hanes et al.) 30 March 2010
US 2006/0179671 A1 (Ghatak) 17 August 2006
DE 102007052819 A1 (Siemens AG) 07 May 2009

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Abstract

Parking Lot

The invention pertains to a parking lot (1) with a plurality of parking spaces (2) for vehicles (3) that have license plates (10) with OCR-readable license numbers (11) and onboard units (12) with radio IDs (15) that can be read out via radio, with said parking lot comprising

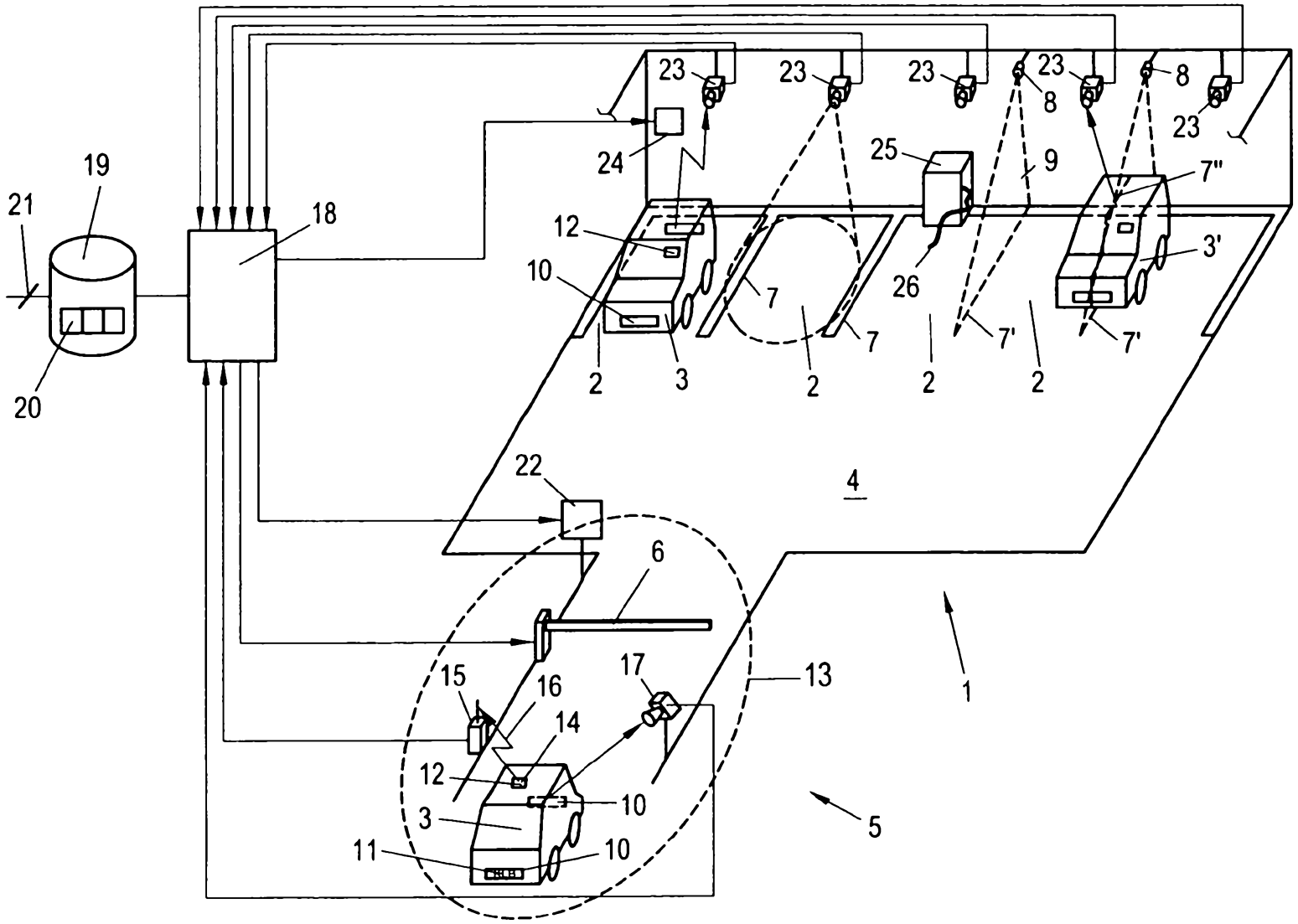
a central computer (18) for storing parking space reservations (20) each comprising an indication of a parking space (2), a vehicle license number (11) and an assigned radio ID (14),

a common radio beacon (15) for the parking spaces (2) that is positioned at an entrance (5) of the parking lot (1) and serves for reading out (10) the radio ID (14) of an entering vehicle (3) via radio and correspondingly signaling the radio ID (14) to the central computer (18), and

at least one stationarily mounted camera unit (23) for each parking space (2) that serves for reading the license number (11) of a vehicle (3) parked therein by means of OCR and correspondingly signaling the license number (11) to the central computer (18),

wherein the central computer (18) is configured to check whether for a radio ID (14) signaled to the central computer the vehicle license number (11) assigned thereto in a stored parking space reservation (20) is subsequently signaled by the camera unit (23) of this parking space (2), and to log instances in which this is not the case.

(Fig. 1)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2012200537 31 Jan 2012

AUSTRALIA

Patents Act 1990

KAPSCH TRAFFICCOM AG

COMPLETE SPECIFICATION
STANDARD PATENT

Invention Title:

Parking lot

The following statement is a full description of this invention including the best method of performing it known to us:-

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Parking Lot

The present invention pertains to a parking lot with a plurality of parking spaces for vehicles that have license plates with OCR-readable license numbers and onboard units with radio IDs that can be read out via a radio.

Parking lot management systems are known in numerous variations. EP 1 986 172 discloses a general reservation system in which identification data is read out via radio when entering and exiting. However, this publication does not provide for the reservation of specific parking spaces and also does not disclose any measures for increasing the functional reliability and the protection against manipulation or any measures for monitoring purposes. Publication US 2004/0068433 discloses a parking lot management and reservation system with a central computer, into which users can enter parking space reservations, e.g., via the Internet, and a camera at the entrance for reading the license numbers of the entering vehicles by means of OCR (optical character recognition) in order to open a barrier for vehicles that have parking space reservations. Parking attendants patrol the parking lot with mobile handheld devices that are connected to the central computer via radio and serve for randomly reading the license numbers of the parked vehicles by means of OCR in order to take action against parking violators. Although systems of this type reach a high degree of automation, they still require manual control processes and are also susceptible to incorrectly read, or even forged, license numbers.

Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present invention as it existed before the priority date of each claim of this application.

Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

The invention aims to reduce the disadvantages of known systems and develop an improved parking lot solution for the fully automated reservation, release, and control of a plurality of parking spaces.

According to the present invention, there is provided a parking lot, comprising:
a plurality of parking spaces for vehicles, each vehicle having a license plate with OCR-readable license numbers and an onboard unit with radio ID that can be read out via radio,

a central computer for storing parking space reservations each comprising a parking space and an assigned radio ID, and

a common radio beacon for the parking spaces that is positioned at an entrance of the parking lot and serves for reading out the radio ID of an entering vehicle via radio and correspondingly signaling the radio ID to the central computer, wherein

in each parking space reservation a vehicle license number assigned to the radio ID is stored,

at least one stationarily mounted camera unit for each parking space is provided that serves for OCR reading the license number of a vehicle parked therein and correspondingly signaling the license number to the central computer, and

the central computer is configured to check whether for a radio ID signaled to the central computer the vehicle license number assigned thereto in a stored parking space reservation is subsequently signaled by the camera unit of this parking space, and to log instances in which the assigned vehicle license number is not signaled in this way.

According to another aspect of the invention, there is provided a method for checking the reservation of a parking lot with a plurality of parking spaces for vehicles, each vehicle having a license plate with OCR-readable license numbers and an onboard unit with radio ID that can be read out via radio, comprising:

storing parking space reservations consisting of parking spaces, vehicle license numbers and assigned radio IDs in a central computer,

reading out the radio ID of an entering vehicle via radio by means of a common radio beacon for the parking spaces that is positioned at an entrance of the parking lot and signaling the radio ID to the central computer, and

for each parking space, OCR reading the license number of a vehicle parked therein by means of at least one stationarily mounted camera unit and signaling the license number to the central computer, and

checking in the central computer whether for a radio ID signaled to the central computer the vehicle license number assigned thereto in a stored parking space reservation is subsequently signaled by the camera unit of this parking space, and logging instances in which the assigned vehicle license number is not signaled in this way.

The invention is based on equipping each individual parking space with an OCR camera unit for reading license numbers in connection with a radio beacon that is able to read out radio onboard units (OBUs) of the vehicles at the entrance. The identification of an entering vehicle takes place via radio, and therefore in a way that is forgery-proof and immune to interference, while the localization and validation of the vehicle in the parking space is once again realized with high-locating-reliability means of optical recognition (OCR). The combination of centralized radio ID and decentralized optical localization and validation allows a fully automated and highly secure operation of the parking lot that is also immune to interference. In this case, it is also possible to make available all known technical functionalities

such as advance reservations via the Internet, automatic billing of the parking fees, automatic actions against parking violations, and statistical evaluations.

At this point, it should be noted that the optical identification of license numbers in parking garages by means of OCR for relocating the parking space of a vehicle is generally known, e.g., from publication DE 10 2007 052 819, wherein the vehicle is not associated with the user until the final checkout process by inputting the license number at the automated pay station, such that this technology is not suitable for a reservation system.

A preferred embodiment of the invention is characterized in that an additional camera for reading the license number of an entering vehicle by means of OCR and correspondingly signaling the central computer is mounted at the entrance, and in that the central computer is furthermore designed for checking whether a signaled radio ID and a vehicle license number signaled by the additional camera unit are assigned to one another in a parking space reservation, as well as for logging instances in which this is not the case. This makes it possible to realize an additional validation stage at the entrance that further increases the protection against misuse of the parking lot.

In order to quickly inform the user, a display panel controlled by the central computer may furthermore be mounted at the entrance and the central computer may be designed for

displaying on the display panel the parking space that is assigned to a signaled radio ID in a parking space reservation.

The parking lot embodying the invention is suitable for interacting with any type of onboard unit that can be read out via radio such as, e.g., transponders carried by vehicles, RFID chips, etc. The radio beacon preferably is a DSRC radio beacon for reading out onboard units of a DSRC (dedicated short-range communication) road toll system via radio. Due to their limited communication range, which can be restricted to the region of the parking lot entrance, DSRC radio beacons provide an increased immunity to interference and a definite allocation and localization of the onboard unit currently being read out.

According to another aspect, the inventive parking lot solution is particularly suitable for equipping the parking spaces with electric vehicle charging stations ("power service stations") that are controlled by the central computer in that it unlocks the charging station for charging a vehicle after successfully checking the vehicle license number signaled by the camera unit of the respective parking space. Due to the inventive combination of radio ID and OCR localization of the vehicle, a highly reliable validation of the vehicle located in a parking space is achieved such that the improper use of charging stations such as, e.g., the charging station of an adjacent (unreserved) parking space, is precluded.

The parking space reservation preferably also contains charging parameters that are specific to the respective vehicle and can be sent to the charging station of the parking space by the central computer. Such charging parameters may, for example, be input into the central computer during the reservation of the parking space by the user or—preferably— be read out from the onboard unit by means of the radio beacon and automatically added to the parking space reservation. For this purpose, charging parameters that are specific to the vehicle are correspondingly stored in the onboard unit such that they can be read out via radio.

This feature is particularly advantageous if the user did not reserve a parking space in advance, but rather directly makes an "ad-hoc" parking space reservation at the entrance, e.g., in order to immediately utilize a currently available parking space with a charging station. All charging parameters that are specific to the vehicle are stored locally in the onboard unit and therefore are immediately available to the charging station. This eliminates the need to query any user data from remote superordinate centers, e.g., via data lines, since such queries would be disadvantageous for an ad-hoc parking space reservation due to the fact that they usually require a longer period of time.

The utilization of a camera unit for the localization of a vehicle in a parking space equipped with a charging station by means of OCR also provides the option of simultaneously using the camera unit for monitoring the charging process, in that the camera unit records a thermal image of the vehicle during the charging process in order to trigger an alarm when a

maximum temperature is exceeded. This makes it possible to prevent dangerous overheating caused, e.g., by defective vehicle batteries or faulty charging processes.

According to another aspect of the invention, the camera units used at the parking spaces can be used not only for the localization and validation of the parking vehicles by means of OCR, but also for the optical control of their correct parking position. Accordingly, another preferred embodiment of the invention is characterized in that at least one parking space is provided with a surface marking that can be detected by its camera unit, wherein the camera unit, in cooperation with the central computer, detects and logs instances in which the surface marking is covered by a vehicle parked thereon,.

It is preferably also possible to provide at least two camera units per parking space that jointly monitor the surface marking thereof, e.g., in order to cover and monitor all areas around a vehicle.

The surface markings may consist of simple color marks on the ground. According to another characteristic of the invention, they are preferably projected on the ground by at least one lighting unit. For example, the lighting unit may project an entire light pattern on the ground, namely also in a variable fashion such that it can specify different sizes of parking spaces, e.g., depending on the occupancy [level] of the parking lot. The projected light pattern also makes it possible to realize a monitoring of the parking position in accordance with the light-section procedure in that the lighting unit preferably projects a light fan onto the ground and the camera unit(s) lies/lie outside the light fan. According to the light-section technology, this makes it possible to recognize surface-marking violations by distortion of the projected intersecting lines of the light fan.

The invention is described in greater detail below with reference to an exemplary embodiment that is illustrated in the attached drawings. The only Figure 1 shows a schematic perspective view of an inventive parking lot, together with electrical components that are illustrated in the form of a block diagram.

Figure 1 shows a parking lot 1 with a plurality of parking spaces 2 for one respective vehicle 3. The parking spaces 2 can be reached from an adjacent traffic area 4 through a common entrance 5. For example, the entrance 5 is provided with a barrier 6, but this barrier is not absolutely imperative. The individual parking spaces 2 are respectively partitioned or separated from one another by surface markings 7, 7'. For example, the surface markings 7 may be applied on the ground with paint or—like the surface markings 7'—projected on the ground in the form of light markings by one or more lighting units 8, e.g., in the form of light fans 9 as will be discussed in more detail later.

Each of the vehicles 3 that use the parking lot 1 conventionally has one or more license plates 10 on which its license number 11 is printed in an optically readable fashion. The vehicles

3 furthermore carry onboard units (OBUs) 12 that can be queried via radio and consist, for example, of onboard units that are used in electronic road toll systems and respectively have a distinct radio ID 14 (OBU-ID) that can be read out via radio. The radio ID 14 usually identifies (only) the onboard unit 12, but may also directly correspond to or contain the license number 11 of the vehicle. The onboard units 12 may consist of separate devices or respectively form part of the electronic system of the vehicles 3.

In addition, a radio beacon 15 is arranged at the entrance 5 in order to read out (arrow 16) the radio ID 14 of the onboard unit 12 of an entering vehicle 3 via radio. The radio beacon 15 preferably has a radio coverage area 13 that is restricted to the region of the entrance 5.

It goes without saying that the radio beacon 15 may also have several distributed radio units, e.g., for an entrance 5 with several lanes, to which a separate radio unit with a radio coverage area restricted to this lane is respectively assigned.

The radio communication 16 for reading out the radio ID 14 via radio preferably takes place in accordance with the DSRC standard (dedicated short-range communication), wherein the radio beacon 15 accordingly consists of a DSRC radio beacon and the onboard unit 12 consists of a DSRC OBU. Alternatively, the radio communication 16 could also take place in accordance with other short-range communication standards such as, e.g., WLAN (wireless local area network), WAVE (wireless access in a vehicle environment), Bluetooth®, RFID (radio frequency identification), NFC (near field communication), etc.

A camera unit 17 for optically reading the license number 11 of an entering vehicle 3 is furthermore mounted at the entrance 5. The radio beacon 15 and the camera unit 17 of the entrance 5 are connected to a central computer 18 of the parking lot 1. The radio beacon 15 signals a radio ID 14 queried by the radio beacon via radio to the central computer 18 and the camera unit 17 also signals a vehicle license number 11 read by the camera unit to the central computer 18.

The vehicle license number 11 read by the camera unit 17 is preferably converted into an alphanumerical value by means of optical character recognition (OCR) and signaled to the central computer 18. It goes without saying that the OCR evaluation algorithm may also be executed on the central computer 18; in this case, the corresponding OCR components of the central computer 18 are also considered to be components of the camera unit 17 if they are not directly implemented therein.

If a barrier 6 is provided, it can also be actuated by the central computer 18.

The central computer 18 features a database 19 with parking space reservations 20 that respectively contain a number or a location of a parking space 2, as well as a vehicle license number 11 and a radio ID 14 of a vehicle 3 assigned to this license number. For example, the

parking space reservations 20 can be entered into the database 19 by the user in advance, e.g., via a web interface 21 of the central computer 18 or its database 19.

When a vehicle 3 enters the parking lot, the radio beacon 15 signals the radio ID 14 of the vehicle 3 to the central computer 18 and the central computer determines the parking space reservation 20 in the database 19 that is associated with the radio ID 14. If the (optional) camera unit 17 is provided, this camera unit can also signal the vehicle license number 11 read by means of OCR to the central computer 18 and the central computer can cross-check the vehicle license number 11 with the vehicle license number stored in the parking space reservation 20.

After a parking space reservation 20 has been validated for the signaled radio ID 14 and the vehicle license number 11 optionally has been successfully cross-checked, the central computer 18 actuates the barrier 6 such that it opens—if such a barrier is provided in the first place. Furthermore, the central computer 18 can display the parking space reservation 20 to the user of the vehicle 3 on a display panel 22 at the entrance 5, e.g., in order to provide the user of the vehicle with visual information concerning the number or the location of the parking space 2. One or more display panels 22 may also be arranged at the parking spaces 2 in order to direct the driver to the respectively reserved parking space.

Instead of the described validation of an "advance" parking space reservation, it would alternatively also be possible to directly make an "ad-hoc" parking space reservation at the entrance 5. In this case, the radio beacon 15 signals the radio ID 14 queried via radio to the central computer 18 and the camera unit 17 signals the vehicle license number 11 read by means of OCR to the central computer, wherein the central computer then determines an available parking space 2 and assigns the radio ID 14, the vehicle license number 11 and the number of the parking space 2 to one another in a parking space reservation 20 in the database 19.

If the radio ID 14 directly corresponds to or contains the vehicle license number 11, a parking space reservation 20 can already be generated based on the radio ID 14 signaled to the central computer 18 only; in this case, the (optional) camera unit 17 can be used for cross-checking the vehicle license number 11 indicated in the radio ID 14 with the vehicle license number 11 in the central computer 18 that was read by means of OCR.

The user subsequently drives the vehicle 3 to the respectively reserved parking space 2. Each parking space 2 is equipped with its own camera unit 23 that reads the license number 11 of the vehicle parking in the respective parking space (or entering the parking space, which is considered to also be encompassed by the term "parking" in this context) by means of OCR. The camera units 23 of the parking spaces 2 respectively signal the vehicle license numbers 11 read by means of OCR to the central computer 18, wherein the OCR algorithms may also be executed on the central computer 18 since it is also to be encompassed by the term "OCR camera units" 23.

After the radio beacon 15 signals a radio ID 14, the central computer 18 is programmed for checking whether the camera unit 23 of the parking space 2 indicated in the parking space reservation 20 together with this radio ID 14 subsequently also signals the vehicle license number 11 indicated in this parking space reservation 20—preferably within a predetermined period of time. If this is the case, the respective car is properly parked and the parking fees can also be correspondingly calculated, e.g., by the central computer 18. If this is not the case, the vehicle 3 obviously has reached an incorrect parking space 2 and this fact is at least logged by the central computer 18; optionally, corresponding alarms, warning messages, or warning announcements can be output with loudspeakers or displayed on information panels 24 of the parking spaces 2.

The readout 16 of the radio ID 14 via radio by means of the radio beacon 15 therefore ensures identification of an entering vehicle 3, which [identification] is immune to interference, and the OCR camera units 23 of the parking spaces 2 ensure a precise localization and validation of the parked vehicle 3.

The camera units 23 may furthermore be used for checking the correct parking position or parking state of the vehicles 3 in the parking spaces 2 in that they optically monitor and evaluate the surface markings 7, 7'. A vehicle 3 that protrudes over a painted surface marking 7 at least partially covers this marking, wherein this can be detected in the camera image of the camera unit(s) 23. A vehicle 3' that protrudes beyond a surface marking 7' projected by means of a light fan 9 distorts the line of light projected on the ground by the light fan 9 into a "profiled" line of light 7" on the vehicle 3', wherein this can be detected in the camera image of a camera unit 23 that does not lie in the same plane as the light fan 9 ("light-section procedure").

One or more parking spaces 2 may furthermore be equipped with charging stations 25 ("power service stations") for electrically charging the parking vehicles 3 via a charging cable 26. In this case, the central computer 18 may be programmed for releasing the charging station 25 in order to charge the vehicle 3 after a successful radio ID and OCR localization and validation of the vehicle 3 in the parking space 2, i.e., if the radio ID 14, the vehicle license number 11 and the parking space number are assigned to one another in the parking space reservation 20.

For this purpose, the radio beacon 15 may also read charging parameters that are specific to the vehicle such as the charging current, the charging characteristics, etc., from the onboard unit 12 via radio and signal these charging parameters to the central computer 18, which in turn transmits said parameters to the corresponding charging station 25. Alternatively, charging parameters that are specific to the vehicle may also be fed into the database 19, e.g., via the web interface 21, and added to the parking space reservations 20. If the user already is a registered

customer of the parking lot, the data may have already been stored in the database 19 of the central computer 18 when the OBU was issued to the user.

In parking spaces 2 with charging stations 25, the camera units 23 assigned to the parking spaces 2 can also be used for monitoring the charging process of the vehicle 3, particularly for detecting overheating or fires. For this purpose, the camera units 23 may optically detect, e.g., a development of excessive light (fire) or additionally record a thermal image of the parked vehicle 3 in order to trigger an alarm and/or immediately shut off the charging station 25 when a maximum temperature is exceeded in the thermal image.

The invention is not limited to the illustrated embodiments, but rather also includes all variations and modifications within the scope of the attached claims.

2012200537 05 Jun 2014

Claims

1. A parking lot, comprising:

a plurality of parking spaces for vehicles, each vehicle having a license plate with OCR-readable license numbers and an onboard unit with radio ID that can be read out via radio,

a central computer for storing parking space reservations each comprising a parking space and an assigned radio ID, and

a common radio beacon for the parking spaces that is positioned at an entrance of the parking lot and serves for reading out the radio ID of an entering vehicle via radio and correspondingly signaling the radio ID to the central computer, wherein

in each parking space reservation a vehicle license number assigned to the radio ID is stored,

at least one stationarily mounted camera unit for each parking space is provided that serves for OCR reading the license number of a vehicle parked therein and correspondingly signaling the license number to the central computer, and

the central computer is configured to check whether for a radio ID signaled to the central computer the vehicle license number assigned thereto in a stored parking space reservation is subsequently signaled by the camera unit of this parking space, and to log instances in which the assigned vehicle license number is not signaled in this way.

2. The parking lot according to Claim 1, wherein at least one parking space is equipped with an electric vehicle charging station that is controlled by the central computer, wherein the central computer is furthermore configured to unlock the charging station for charging the vehicle after successfully checking the vehicle license number signaled by the camera unit of this parking space.

3. The parking lot according to Claim 2, wherein the parking space reservation for said parking space contains charging parameters that are specific to the vehicle and transmitted to the charging station by the central computer.

4. The parking lot according to Claim 3, wherein the charging parameters specific to the vehicle are read from the vehicle's onboard unit by the radio beacon and added to the parking space reservation.

5. The parking lot according to any one of the Claims 2 to 4, wherein the camera unit of said parking space also records a thermal image of the vehicle during the charging process in order to trigger an alarm if a maximum temperature is exceeded.

6. The parking lot according to any one of the Claims 1 to 5, wherein an additional camera unit for OCR reading the license number of an entering vehicle and signaling the license number to the central computer is mounted at the entrance, and wherein the central computer is furthermore configured to check whether a signaled radio ID and a vehicle license number signaled by the additional camera unit are assigned to one another in a parking space reservation, and to log instances in which this is not the case.

7. The parking lot according to any one of the Claims 1 to 6, wherein a display panel is mounted at the entrance and controlled by the central computer, and wherein the central computer is configured to display on the display panel the parking space that is assigned in a parking space reservation to a radio ID signaled to the central computer.

8. The parking lot according to any one of the Claims 1 to 7, wherein the radio beacon is a DSRC radio beacon for reading out onboard units of a DSRC road toll system via radio.

9. A method for checking the reservation of a parking lot with a plurality of parking spaces for vehicles, each vehicle having a license plate with OCR-readable license numbers and an onboard unit with radio ID that can be read out via radio, comprising:

storing parking space reservations consisting of parking spaces, vehicle license numbers and assigned radio IDs in a central computer,

reading out the radio ID of an entering vehicle via radio by means of a common radio beacon for the parking spaces that is positioned at an entrance of the parking lot and signaling the radio ID to the central computer, and

for each parking space, OCR reading the license number of a vehicle parked therein by means of at least one stationarily mounted camera unit and signaling the license number to the central computer, and

checking in the central computer whether for a radio ID signaled to the central computer the vehicle license number assigned thereto in a stored parking space reservation is subsequently signaled by the camera unit of this parking space, and logging instances in which the assigned vehicle license number is not signaled in this way.

10. The method according to Claim 9 for a parking lot of which at least one parking space is equipped with an electric vehicle charging station that is controlled by the central computer wherein the central computer unlocks the charging station for charging the vehicle after successfully checking the vehicle license number signaled by the camera unit of this parking space.

11. The method according to Claim 10, wherein the parking space reservation for said parking space contains charging parameters that are specific to the vehicle and transmitted to the charging station by the central computer.

12. The method according to Claim 11, wherein the charging parameters specific to the vehicle are read from the onboard unit by the radio beacon and added to the parking space reservation.

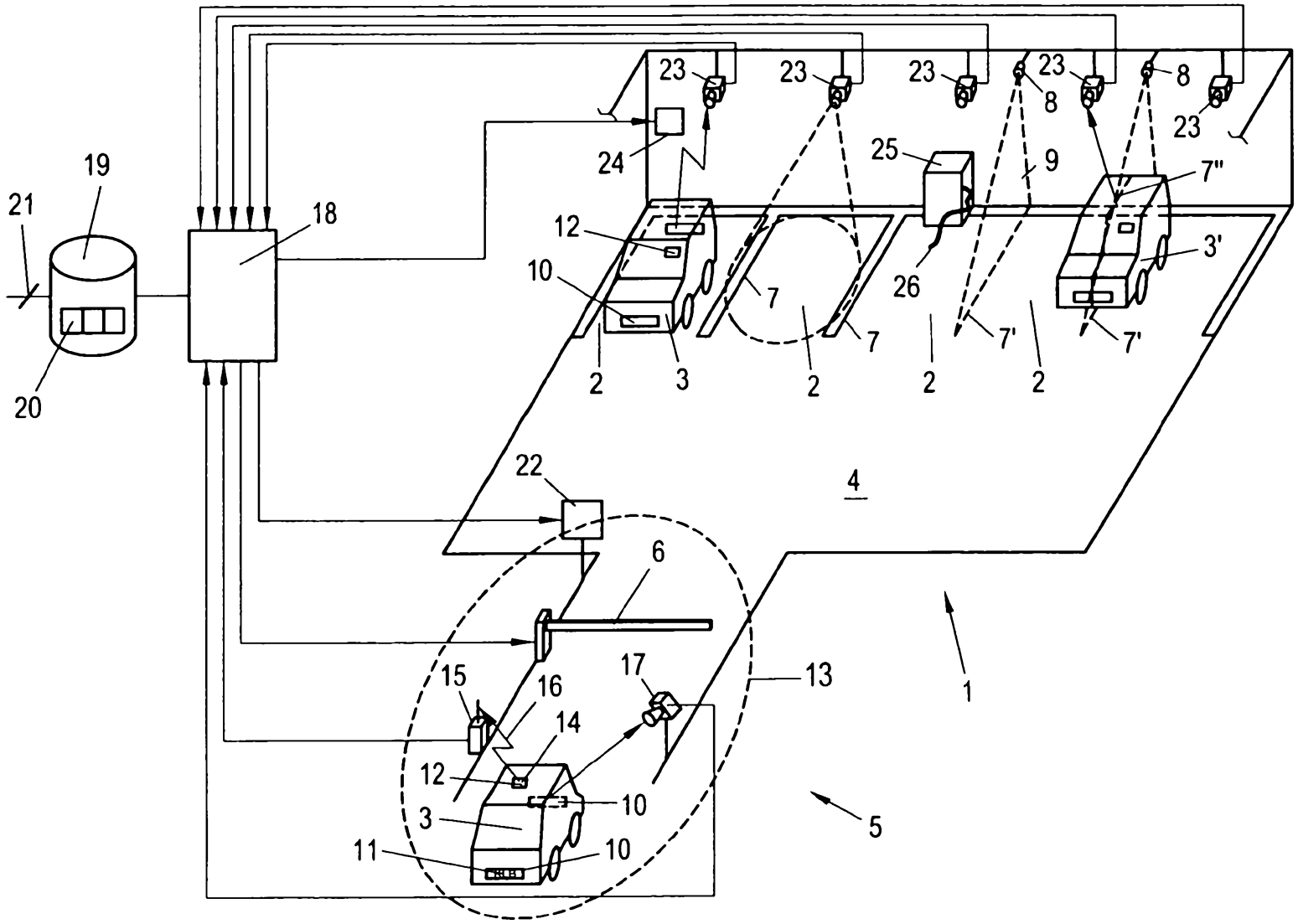
13. The method according to any one of the Claims 10 to 12, wherein the camera unit of said parking space also records a thermal image of the vehicle during the charging process in order to trigger an alarm if a maximum temperature is exceeded.

14. The method according to any one of Claims 9 to 13 for a parking lot at the entrance of which an additional camera unit for OCR reading the license number of an entering vehicle and signaling the license number to the central computer is mounted, wherein the central computer checks whether a signaled radio ID and a vehicle license number signaled by the additional camera unit are assigned to one another in a parking space reservation, and logs instances in which this is not the case.

15. The method according to any one of the Claims 9 to 14, wherein the central computer displays, on a display panel mounted at the entrance, the parking space that is assigned in a parking space reservation to a radio ID signaled to the central computer.

16. A parking lot substantially as hereinbefore described with reference to the accompanying drawings.

17. A method for checking the reservation of a parking lot with a plurality of parking spaces for vehicles, the method substantially as hereinbefore described with reference to the accompanying drawings.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