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(54) **System and method for vehicle localization and automatic parking payment**

(57) The present invention herein refers to a system and a method for localising vehicles and for the automation of parking payment. In an embodiment the system for handling a vehicle parking area (10) is characterised in that it comprises: an RF-ID tag (12) positioned in every space (35, 36) designated to vehicle parking (10) having associated an identification code of said space; a reader of RF-ID tag (13), positioned on said

vehicle (10), suitable for reading said identification code from said RF-ID tag (12), for determining the presence of said vehicle (10) in said space (35, 36); transmission means (13, 15, 27), positioned on said vehicle (10), suitable for transmitting said identification code to a control centre (32); said control centre (32) associates with said identification code the corresponding localisation of said space (35, 36).

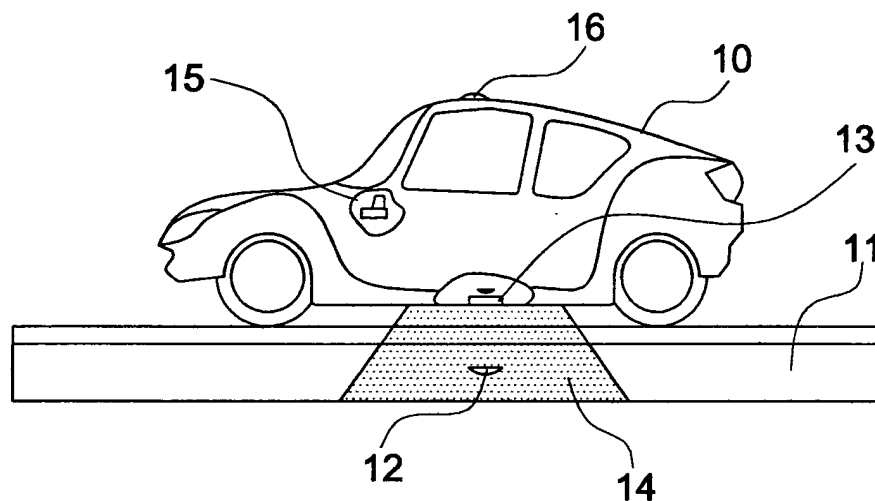


Fig.1

Description

[0001] The present invention refers to a system and method for localising vehicles and for the automatic parking payment.

[0002] The problem of automating the parking payment has been widely studied given the importance that it covers. The solutions of this problem can be divided into two categories. The first relating to parking with entrance gate and the second relating to parking in open areas.

[0003] For the first category the problem to be solved relates to knowing if a vehicle has entered through the entrance gate and to identifying it.

[0004] For the second category the problem to be solved relates to identifying for every parking area the presence or not of a vehicle and to its identification.

[0005] The object of the present invention is to provide for a system for localising vehicles, relating to parking in open areas, that is simple to carry out and that requires limited installation investments.

[0006] In accordance with the present invention, this object is achieved by means of a system for handling a parking area for vehicles characterised in that it comprises: an RF-ID tag positioned in every space designated to vehicle parking having an identification code of said space associated; a reader, positioned on said vehicle, suitable for reading said identification code from said RF-ID tag, for determining the presence of said vehicle in said space; transmission means, positioned on said vehicle, suitable for transmitting said identification code to a control centre; said control centre associates to said identification code the corresponding localisation of said space.

[0007] This object is also achieved by means of a method for handling the automatic payment of vehicle parking characterised in that it comprises the following phases: positioning an RF-ID tag in a vehicle parking space having associated an identification code of said space; positioning a reader of RF-ID tag in said vehicle suitable for reading said identification code from said RF-ID tag; detecting the presence of a vehicle in said vehicle parking space by means of said RF-ID tag reader; transmitting said identification code from said vehicle to a control centre; associating with every identification code a localisation of said space and an indication that in said space a vehicle is present.

[0008] Thanks to the present invention it is possible to produce a system for handling a parking area for vehicles that considerably reduces the costs of installation, installing only an RF-ID tag for each parking area, no cabling is required and not even any special maintenance. The RF-ID tag reader is positioned on the vehicle.

[0009] Having transmitted the identification code to the control centre, the control centre, in addition to identifying, among the multiple vehicle parking areas, the one occupied by the vehicle in question, associates the relative hourly tariff of that specific parking area. If necessary, an identification code of the vehicle (for example the number plate of the same vehicle) is also transmitted for eventual debiting of the payment. To identify the beginning and the end of the parking time, with the purpose, for example, of calculating the amount of the payment, it is possible, for example, to use the information regarding the vehicle being switched off and started up or any other information on board the vehicle. If necessary, information concerning the hourly tariff payment of the parking area and the other information of interest are sent to the vehicle. Given that with the present system every vehicle communicates its presence in a certain parking area to a central data bank, all the information relating to the state of occupation of all the parking areas controlled is available. The data present can be used for developing added value services.

[0010] In the coming years all the vehicles will be fitted with telematic equipment for various purposes and thus the present invention will not require the installation of additional equipment but it will be sufficient to integrate that already present.

[0011] The characteristics and advantages of the present invention will appear evident from the following detailed description of an embodiment thereof, illustrated as non-limiting example in the enclosed drawings, in which:

Figure 1 shows a parking area and a vehicle parked in accordance with the present invention;

Figure 2 shows a block diagram of the system for handling a vehicle parking area in accordance with the present invention;

Figure 3 shows a vehicle parking area in accordance with the present invention.

[0012] In reference to Figure 1, a vehicle 10 is shown in a parked position. In the ground 11, under the road surface, an RF-ID tag 12 is installed. On vehicle 10, preferably in its lower part, a reader 13 of the RF-ID tags (Radio Frequency Identification) 12 is mounted, having an antenna with a radiation pattern 14 positioned so as to be able to be in communication with the RF-ID tag 12.

[0013] The reader 13 is in communication with a telematic apparatus 15, positioned on board the vehicle 10, fitted with an antenna 16, for the transmission and reception of information.

[0014] Figure 2 shows a block diagram of the system for handling a vehicle parking area in accordance with the present invention. It can be divided into four physically separated units. Unit 20 relating to the road/parking area, unit 21 relating to the vehicle area, unit 22 represents the communication infrastructure between vehicle and control centre

(e.g. cellular network) and unit 23 relating to a control centre.

[0015] In unit 20 the RF-ID tags 12 can be found with their relative antennas 24.

[0016] In unit 21 we find an antenna 25 of the reader 13, the latter being coupled to the telematic apparatus 15. The telematic apparatus 15 is coupled to the electronic system on board (from which, for example, the information relating to the motor being switched off and started up, can be read) the vehicle 10 by means of the bus 26, and also a first communication system 27 having the antenna 16.

[0017] Unit 22, which represents the communication infrastructure between vehicle and control centre, is composed, for example, in the case of a cellular network GSM/GPRS, of a second communication system 29 (Base Station), with the relative antenna 28, suitable for communicating with the first communication system 27 (modem GSM/GPRS). The second communication system 29 is connected to a communication network 30 which in turn is connected to a third communication system 31 (router IP).

[0018] In unit 23 of the control centre there is a system for handling parking areas 32, connected to the third communication system 31, and to a data bank 33.

[0019] The system in accordance with the present invention enables the user's vehicle to be localised inside every parking area. Knowing that the vehicle is occupying a specific parking lot enables the system for the calculation of the parking fees, on the basis of the time spent by the vehicle in the parking area, and on the basis of the hourly tariff of that specific parking area.

[0020] The system requires the parking areas to be equipped with RF-ID tag 12. Each parking area must have an RF-ID tag 12. Each RF-ID tag 12 must have an identification code, which is unequivocally associated with the parking area in which it has been mounted. The RF-ID tags can be put, for example, on the surface of the road or incorporated into the pavement of the road. This installation therefore enables a correspondence between the RF-ID tag and each parking area to be established, and, as the code associated with each RF-ID tag is unique, each parking area associated with the RF-ID tag can be unmistakeably identified.

[0021] The vehicles 10 are equipped with a reader 13 of the RF-ID tags 12 of the RF-ID type.

[0022] The RF-ID technology used can be for example that at 2.45Ghz (ISO 18000-Part 4) or at 5.8Ghz (ISO 18000-Part 5). Both frequencies, which correspond to wavelengths in air to the order of 12 cm and 6 cm respectively, permit directive antennas to be made of dimensions of the same order as the wave lengths mentioned, and therefore compatible with the installation on board the vehicle.

[0023] In the present description reference is made to RF-ID tag 12 and to readers 13 of RF-ID tag 12, but any other technology can be used (for example optical, acoustic, infrared) that permit remote interrogation by means of a reader 13, a device 12, active or passive, that supplies a single identification code and that is easy to install.

[0024] The antenna 25 of the reader 13 must be directed towards the road surface, and positioned in the lower part of the vehicle 10. Alternately the antenna can be positioned inside the bumper bars, and always directed downwards, so as to enable the RF-ID tags 12 mounted on the road surface to be read.

[0025] The radiation pattern 14 of the antenna 25, and the power of the reading signal emitted by the reader 13, must be such that the reading area on the ground measures approximately one meter.

[0026] The reading area must be controlled for two reasons. The RF-ID tags 12 that are not immediately under the vehicle must not be read, in fact, if this happened, that is if the reading signal spread to RF-ID tags 12 of nearby parking spaces with sufficient intensity to appear in their reading, the position of the vehicle 10 could not be associated with a single RF-ID tag, and therefore not unmistakeably determined. The power of the reading signal must therefore be limited and the radiation pattern 14 of the antenna 25 must be directive, so as to guarantee that only the single RF-ID tag 12 under the vehicle 10 can be read, and that the RF-ID tags 12 of nearby parking spaces are not reached by a reading signal with such an intensity as to activate them. Provided that the previous conditions are observed, the dimensions of the reading area must not be too small, such that if the vehicle parked was not perfectly aligned with the RF-ID tag, its reading would be impossible.

[0027] The production of the system could thus provide for a ground reading area, for example, of 1 meter. Typical angled parking in fact has a width of 2.5 metres and parallel parking 2.1 metres, therefore a reading area of 1 metre guarantees that the RF-ID tags of the nearby parking spaces cannot be read simultaneously. Said reading area thus enables the system to read the RF-ID tag 12 even if the driver has not parked his vehicle in perfect alignment with the RF-ID tag 12 itself. The tolerance in parking would be in fact +/- 0.5 metres in the two directions. In relation to this see Figure 3 where two parking areas 35 and 36 are shown, seen from above, outlined with suitable demarcation strips 37, set up with the RF-ID tags 12, placed in a central position of the parking spaces. A radiation pattern 14 of a possible vehicle parked in parking space 35 is also shown.

[0028] The telematic apparatus 15 on board the vehicle will have to examine the reader 13 continuously to find out if an RF-ID tag 12 has been read. This event, combined with other information (for example if the vehicle has stopped, or the engine has been switched off) will indicate that the user has parked his vehicle 10 on the parking area identified by the RF-ID tag 12 read.

[0029] The telematic apparatus 15 at this point will send, by means of means 27, 29, 30 and 31, to the control centre

23 the identification of the vehicle (for example the number plate of the vehicle), or the user, and the identification code read by the RF-ID tag 12. The control centre 23 will interrogate its data bank 33, and on the basis of the information memorised in it (for example the hourly tariff payment of the parking area in question), will start the payment operations. It is preferable that these operations also include transmission to the user of a start payment signal, for the parking space occupied, and the hourly tariff.

[0030] This information can be transmitted either through the transmission system previously described, or through personal apparatus that can be associated with the user (for example by means of SMS messages to a mobile telephone, or a communication towards a PDA). The telematic apparatus 15 will have to keep the events that indicate that the user has left the parking space, as the event that vehicle 10 has started to move and that has left the parking space free. These events will bring about a new communication between the telematic apparatus 15 and the control centre 23.

[0031] The second communication system 29 will be capable of receiving and possibly transmitting information, on one hand, with the first communication system 27, placed on the vehicle, on the other hand, to the control centre 23. These latter communications can be for example transmitted either directly or by means of a connection to the communication network 30 (for example cellular communication network). In turn, the communication network 30, is connected to a third communication system 31 or to interface with the control centre 23.

[0032] The telematic apparatus 15 typically comprises a microprocessor, a memory, a communication interface towards the bus 26 of the automobile (e.g. CAN, MOST), a communication interface towards reader 13 of RF-ID (e.g. serial RS-232, USB), a communication interface towards the first communication system 27 (e.g. RS-232, USB), and the first communication system 27 (e.g. modem GSM/GRPS).

[0033] Summing up, the flow of information between the functional elements of the system is the following.

[0034] The reader 13 extracts the identification code of an RF-ID tag 12 placed on the road surface.

[0035] Telematic unit 15 on board vehicle 10 sends the identification code of the RF-ID tag 12 and the identification code of the vehicle, or of the user, to the system for handling parking areas 32.

[0036] The system for handling parking areas 32 extracts from the data bank 33 the information relating to the parking space corresponding to the identification code of the RF-ID tag 12 read.

[0037] The system for handling parking areas 32 sends the information relating to the parking space to the telematic unit 15 of the vehicle 10.

[0038] Telematic unit 15 sends a message to confirm that the vehicle has been parked.

[0039] The system for handling parking areas 32 updates the data bank 33 of the parking spaces.

[0040] The vehicle 10 signals the end of the parking period.

[0041] The system for handling parking areas 32 updates the data bank 33 of the parking spaces and reads the information needed for payment on the data bank 33.

[0042] When the system for handling parking areas 32 receives a message relating to the parking of a vehicle, it recuperates the information relating to the parking area from the data bank 33 to which the message makes reference and if required sends it to the telematic unit 15 of the vehicle concerned. Successively, the system for handling parking areas 32 awaits a confirmation or parking completed message (e.g., signal that the engine of the vehicle has been switched off) from the latter. After having received it, it marks the parking space identified as occupied and starts calculating the parking time. An example of the data bank 33 relating to the above-mentioned information is shown in Table 1.

Table 1

Parking area identification code	Vehicle identification code	Location	Hourly tariff
001	TO123456	C.so Trento	1 €/h
002	--	C.so Trento	1 €/h
003	--	C.so Trento	1 €/h
004	TO987654	C.so Abruzzi	0,5 €/h
005	--	C.so Abruzzi	0,5 €/h
006	--	C.so Abruzzi	0,5 €/h

[0043] When the system for handling parking areas 32 receives a message relating to the end of the parking period (e.g. signal that the engine of the vehicle 10 has been started up), it calculates the fee, carries out the payment transaction (e.g. by means of credit card or on the telephone account) and marks the parking space as available. For example in the data bank 33 there are references relating to the vehicles parked as shown in Table 2.

Table 2

Vehicle identification code	Owner identification code	Type of payment
TO123456	Aaaaa Bbbbb	VISA no
TO987654	Ccccc Ddddd	VISA no
MI123456	Eeeee Fffff	VISA no

Claims

1. System for locating the vehicles (10) and for the automation of parking payment **characterised in that** it comprises: an RF-ID tag (12) positioned in every space (35, 36) designated to vehicle parking (10) having associated an identification code of said space; a reader of RF-ID tag (13), positioned on said vehicle (10), suitable for reading said identification code from said RF-ID tag (12), for determining the presence of said vehicle (10) in said space (35, 36); transmission means (13, 15, 27), positioned on said vehicle (10), suitable for transmitting said identification code to a control centre (32); said control centre (32) associates to said identification code the corresponding localisation of said space (35, 36).
2. System in accordance with claim 1 **characterised in that** said transmission means (13, 15, 27) transmit an identification code of the vehicle (10) to said control centre (32).
3. System in accordance with claim 1 **characterised in that** said control centre (32) includes first means (33) for memorising each space (35, 36) marked by said RF-ID tag (12) and second means for memorising (33) associated to corresponding first means (33) for memorising suitable for memorising the presence or not of a vehicle (10) in each of said corresponding spaces (35, 36), and third means for memorising (33) relating to the hourly tariff of each space (35, 36).
4. System in accordance with claim 1 **characterised in that** transmission means (13, 15, 27) transmit to said control

centre (32) information regarding the beginning of the parking period of said vehicle (10) in said space (35, 36).

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5. System in accordance with claim 4 **characterised in that** transmission means (13, 15, 27) transmit to said control centre (32) information regarding the end of the parking period of said vehicle (10) in said space (35, 36).

- 10
6. System in accordance with claim 5 **characterised in that** said control centre (32) associates to said identification code a corresponding hourly payment tariff and includes calculation means which on the basis of said information regarding the beginning and the end of a parking period of said vehicle (10) in said space (35, 36) determine the amount of the parking payment of said vehicle (10).

- 15
7. Method for handling the automatic payment of parking vehicles (10) **characterised in that** it comprises the following phases: positioning an RF-ID tag (12) in a parking space (35, 36) of a vehicle (10) having associated an identification code of said space (35, 36); positioning a reader of RF-ID (13) in said vehicle (10) suitable for reading said identification code from said RF-ID tag (12); detecting the presence of a vehicle (10) in said parking space (35, 36) of a vehicle (10) by means of said reader of RF-ID (13); transmitting said identification code from said vehicle (10) to a control centre (32); associating with every identification code a localisation of said space (35, 36) and an indication that in said space (35, 36) a vehicle is present (10).

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8. Method in accordance with claim 7 **characterised in that** it transmits to said control centre (32) information regarding the beginning and the end of the parking period of vehicle (10) in said space (35, 36).

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9. Method in accordance with claim 8 **characterised in that** said information regarding the beginning of the parking period of said vehicle (10) in said space (35, 36) corresponds to the indication of when the engine of said vehicle (10) is switched off and that said information regarding the end of the parking period of said vehicle (10) in said space corresponds to the indication of when the engine of said vehicle (10) is turned on.

- 30
10. Method in accordance with claim 7 **characterised in that** said vehicle (10) comprises receiving means (27) and said control centre (32) transmits to said vehicle (10) said localisation of said space (35, 36) and information relating to the corresponding hourly payment tariff of said space (35, 36).

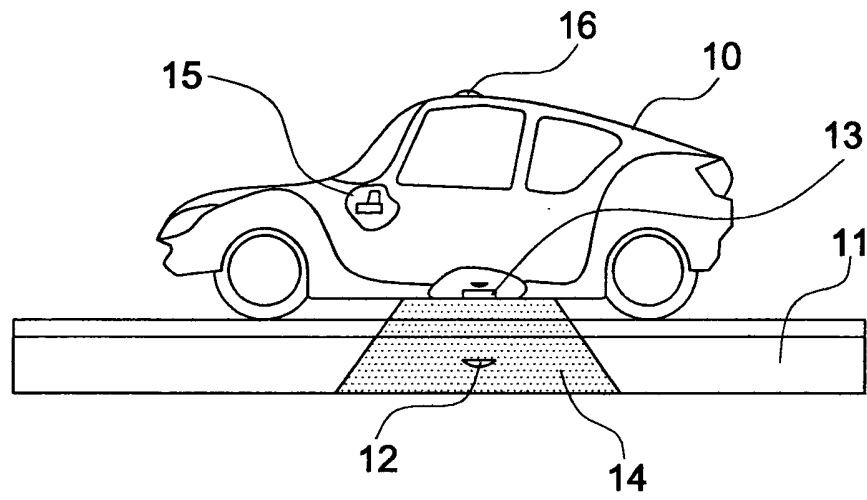


Fig.1

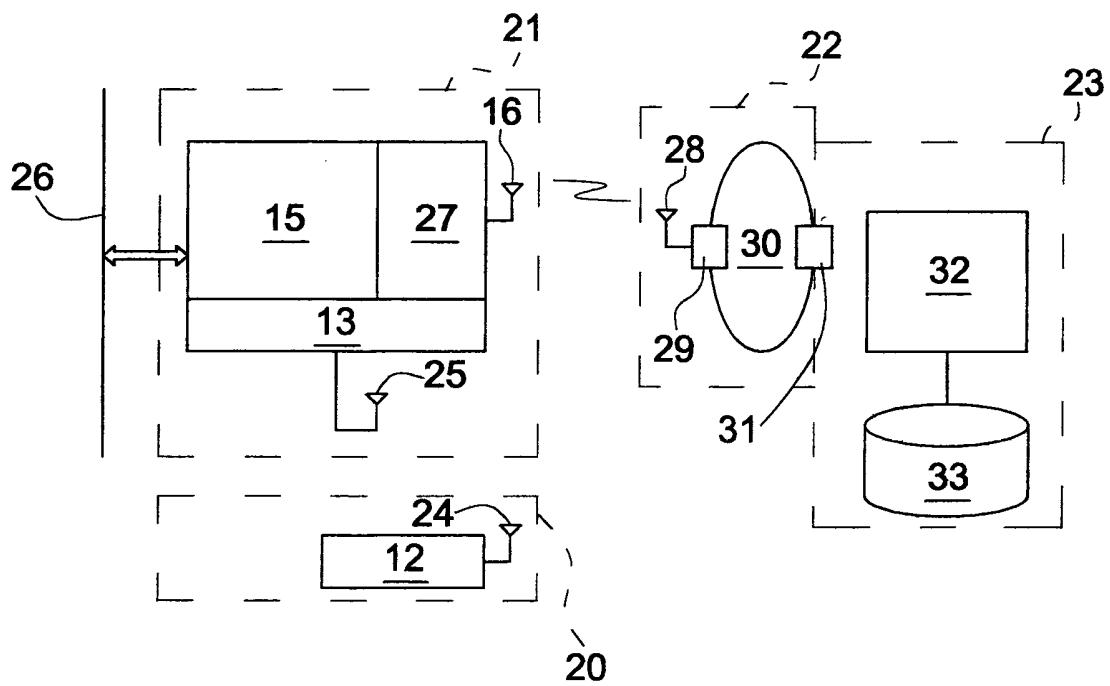


Fig.2

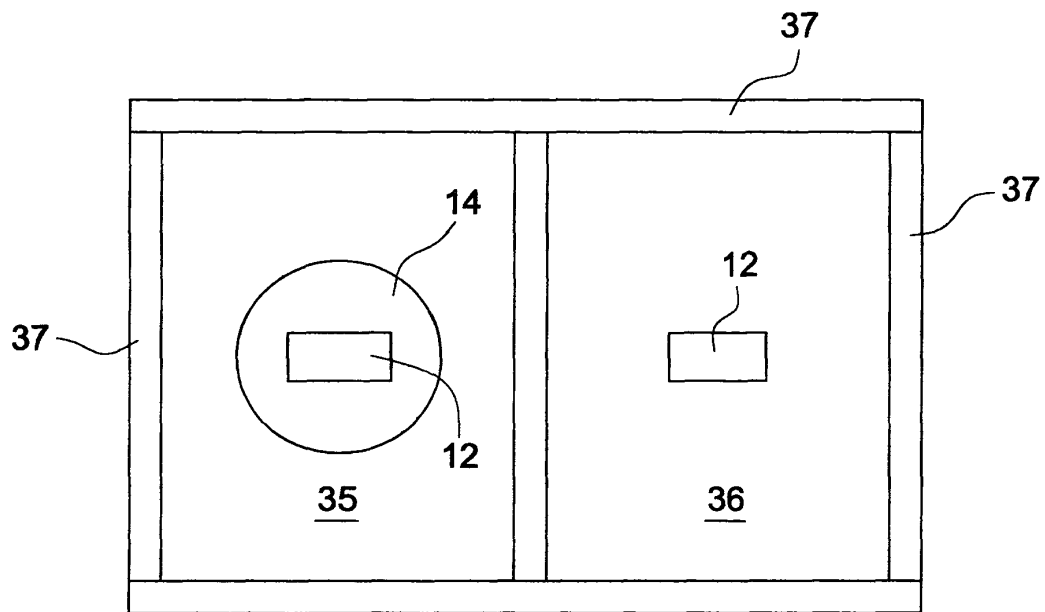


Fig.3



European Patent
Office

EUROPEAN SEARCH REPORT

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Place of search Munich		Date of completion of the search 24 September 2004	Examiner Rother, S
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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