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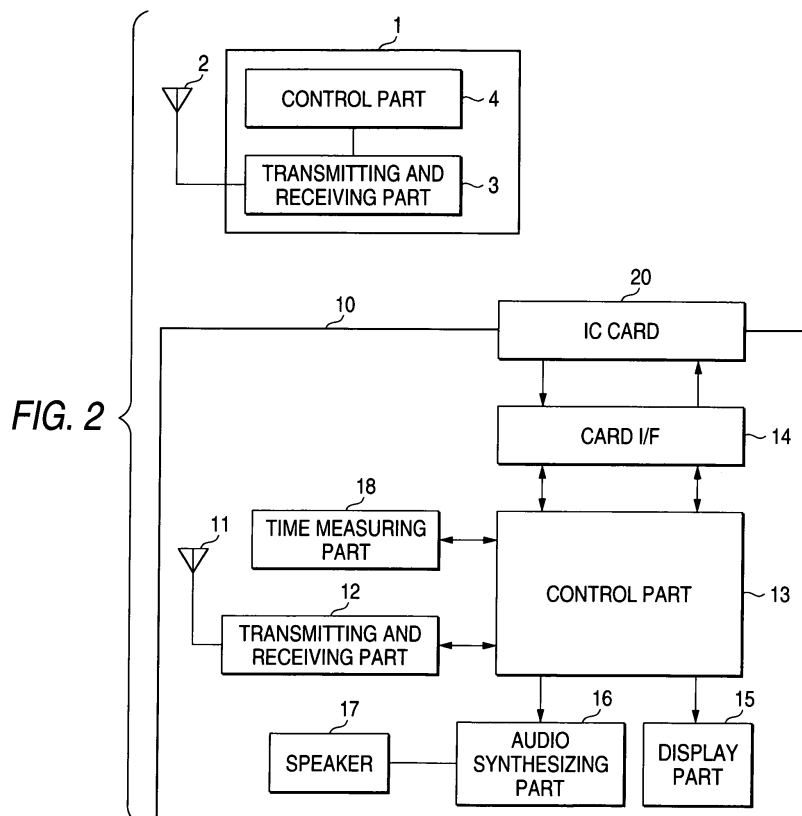
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(54) **Automatic parking permission time information system**

(57) A vehicle mount device 10 reads the balance of an inserted IC card 20 to transmit data to a roadside device 1. The roadside device 1 calculates and transmits a parking permission time in accordance with balance to the vehicle mount device 10. The vehicle mount device 10 outputs the parking permission time from a display part 15 and a speaker 17. The vehicle mount device 10

monitors an elapse time on the basis of time data from a time measuring part 18. When the elapse time exceeds the parking permission time upon leaving a parking place, the vehicle mount device informs a user of the above-described fact and an insufficient charge. When the parking permission time passes, the roadside device may inform the user of the lapse of the parking permission time through a portable telephone.



## Description

### BACKGROUND OF THE INVENTION

**[0001]** The present invention relates to an automatic parking fee receiving system for adjusting a parking fee by a radio communication between a vehicle mount device using an IC card in which prepaid balance is stored and a roadside device installed in a parking place.

**[0002]** As an automatic charge receiving system using a prepaid card in a parking place, a charge receiving system has been usually used in which a user inserts the prepaid card into an adjustment calculator in a gate to perform a fee adjustment when the user leaves the parking place. On the other hand, an automatic charge receiving system has been known that a toll is paid by the prepaid card using a radio between a roadside device installed in the tollgate of a toll road and the vehicle mounted device (for instance, JP-A-2002-123846).

**[0003]** However, in the usual automatic charge receiving system in the parking place, prepaid balance is unknown until the card is inserted into the adjustment calculator. When the balance is deficient, the fee adjustment needs to be carried out again. Further, in the usual automatic charge receiving system in the toll road, when the prepaid balance is deficient, a user cannot pass the tollgate, so that a traffic jam is undesirably caused.

### SUMMARY OF THE INVENTION

**[0004]** The present invention solves these problems as described above and it is an object of the present invention to provide an automatic parking fee receiving system that can previously inform a user of information as to how many hours a vehicle can be parked from the present prepaid balance of an IC card when the vehicle passes an entrance gate of a parking place.

**[0005]** An automatic parking-fee receiving system according to the present invention has a structure comprising: a roadside device for calculating a parking permission time from prepaid balance sent from a vehicle mount device and transmitting the parking permission time to the vehicle mount device; and the vehicle mount device including a transmitting and receiving unit for transmitting and receiving data between the roadside device and the vehicle mount device, a card interface unit for reading and writing data on an IC card in which the prepaid balance is stored, a control unit for transmitting the prepaid balance read from the IC card to the roadside device through the transmitting and receiving unit and an informing unit for informing a user of the parking permission time received from the roadside device.

**[0006]** According to this structure, when a vehicle passes the entrance gate of a parking place, a user can be previously informed of the parking permission time from the present prepaid balance. Thus, the user can decide at what time the user may leave the parking place. Further, when a parking time is likely to exceed the park-

ing permission time, the user can prearrange to perform a parking fee adjustment by cash.

**[0007]** Further, in the automatic parking-fee receiving system according to the present invention, the informing unit may inform the parking permission time by at least one of a display or an audio. According to this structure, the user can visually or audibly know the parking permission time.

**[0008]** Further, in the automatic parking fee receiving system according to the present invention, the vehicle mount device may include a time measuring unit for outputting time data, when the control unit fetches the time data from the time measuring unit and receives the parking permission time from the roadside device, the control unit calculates an elapse time from that time until departure and compares the parking permission time with the elapse time, and when the elapse time is longer than the parking permission time, the control unit alarms a user by the informing unit. According to this structure, when the present prepaid balance is deficient for a parking fee, the user can be previously informed that the user needs to adjust by cash.

**[0009]** Further, in the automatic parking fee receiving system according to the present invention, the control unit may store the time data from the time measuring unit when the control unit receives the parking permission time from the roadside device, and calculate the elapse time from the time data and time data when a power is turned on upon departure after parking. According to this structure, the elapse time can be calculated even when the power of the vehicle is turned off because of parking.

**[0010]** Further, in the automatic parking fee receiving system according to the present invention, the control unit may calculate a deficient balance when the elapse time is longer than the parking permission time. According to this structure, the user can be previously informed of a deficient amount of money.

**[0011]** Further, in the automatic parking fee receiving system according to the present invention, the time measuring unit may be provided in an external device and the time data is obtained from the external device. According to this structure, even when a time calculating unit is not incorporated in the vehicle mount device, the elapse time can be obtained.

**[0012]** Further, in the automatic parking fee receiving system according to the present invention, the external device may be a navigation device. According to this structure, even when the time measuring unit is not incorporated in the vehicle mount device, if the navigation device is mounted on the vehicle, the elapse time can be obtained from the navigation device.

**[0013]** Further, in the automatic parking fee receiving system according to the present invention, the control unit may transmit the E mail address or the telephone number of a portable telephone together with the prepaid balance to the roadside device and the roadside device can inform the E mail address or the telephone number that the parking permission time passes or has passed

before the calculated parking permission time passes or after the calculated parking permission time has passed. According to this structure, the user can know the lapse of the parking permission time corresponding to the present prepaid balance through the portable telephone even when the user is present outside the vehicle. Thus, the user can be prevented from paying an excessive parking fee, because the user is outside the vehicle and does not know the excess of the parking permission time.

**[0014]** Further, in the automatic parking fee receiving system according to the present invention, the roadside device may inform the E mail address or the telephone number of the lapse of the calculated parking permission time before a prescribed time of the lapse of the calculated parking permission time. According to this structure, the user who is present even outside the vehicle can previously know that the current prepaid balance is insufficient for a parking fee when the vehicle is continuously parked in the parking place as it is and can rapidly return to the vehicle to prevent the excess of the parking fee.

**[0015]** As described above, in the automatic parking fee receiving system of the present invention, since the roadside device calculates the parking permission time from the prepaid balance sent from the vehicle mount device and transmits the parking permission time to the vehicle mount device, the user can be previously informed of the parking permission time from the present prepaid balance of the IC card. Thus, the user can decide at what time the user may leave the parking place. Further, when a parking time is likely to exceed the parking permission time, the user can prearrange to adjust the parking fee by cash.

#### BRIEF DESCRIPTION OF THE DRAWINGS

##### **[0016]**

Fig. 1 is a block diagram showing the structure of an automatic parking fee receiving system in a first embodiment of the present invention.

Fig. 2 is a block diagram showing the structure of an automatic parking fee receiving system in a second embodiment of the present invention.

Fig. 3 is a block diagram showing the structure of an automatic parking fee receiving system in a third embodiment of the present invention.

Fig. 4 is a block diagram showing the structure of an automatic parking fee receiving system in a fourth embodiment of the present invention.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0017]** Now, embodiments of the present invention will be described by way of the drawings.

(First Embodiment)

**[0018]** Fig. 1 is a block diagram showing the structure of an automatic parking fee receiving system in a first embodiment of the present invention. In Fig. 1, a roadside device 1 is located in the entrance gate and the exit gate of a parking place and includes an antenna 2 for performing a DSRC (dedicated short range communications) using a frequency band of 5.8 GHz, a transmitting and receiving part 3 for modulating and demodulating transmitting and receiving signals and a control part 4 for controlling data transmitted and received between the roadside device and a vehicle mount device 10. When the roadside device 1 includes the entrance gate and the exit gate disposed adj acently to each other, the roadside device has a function for deciding to which of the gates the vehicle moves. The vehicle mount device 10 includes an antenna 11 mounted on a vehicle to transmit and receive a radio wave between the antenna 2 of the roadside device 1 and the antenna 11, a transmitting and receiving part 12 for modulating and demodulating transmitting and receiving signals, a control part 13 for controlling data transmitted and received between the roadside device 1 and the vehicle mount device and a slot into which an IC card 20 on which prepaid balance is stored is inserted. Further, the vehicle mount device 10 includes a card interface 14 for reading and writing data in the IC card 20, a display part 15 for displaying characters or graphics by a liquid crystal display or a light emitting diode, an audio synthesizing part 16 in which an audio for an outputted message is stored and a speaker 17 for outputting the message as an audio.

**[0019]** Now, an operation of the first embodiment will be described below. Initially, when the vehicle on which the vehicle mount device 10 is mounted comes near to the entrance gate of the parking place, the roadside device 1 and the vehicle mount device 10 start a communication. The control part 13 of the vehicle mount device 10 reads out the prepaid balance of the IC card 20 through the card interface 14 and controls the transmitting and receiving part 12 to transmit the data of the prepaid balance to the roadside device 11 through the antenna 11. When the roadside device 1 receives the data of the prepaid balance by the antenna 2 and the transmitting and receiving part 3, the control part 4 calculates a parking permission time in accordance with the prepaid balance on the basis of a charge for use per time of the parking place and responds to the vehicle mount device 10. The control part 13 of the vehicle mount device 10 outputs the received parking permission time as a message, for instance, " your parking permission time is some hours and some minutes", by either or both of a text indication by the display means 15 or an audio announce by the audio synthesizing part 16 and the speaker 17.

**[0020]** As described above, according to the first embodiment of the present invention, the roadside device 1 calculates the parking permission time from the prepaid balance sent from the vehicle mount device 10 and trans-

mits the parking permission time to the vehicle mount device 10. Thus, the vehicle mount device 10 side can previously know the parking permission time based on the prepaid balance. A user can previously decide at what time the user may leave the parking place and whether or not a parking time may possibly exceed the parking permission time.

In this embodiment, a prepaid system using the IC card is described as an example. However, an embodiment of the present invention is not limited to the IC card and memory media such as an SD card, a memory stick, a smart media, a multi-media card may be employed. Further, removable flash memory devices are also applicable. Furthermore, according to the above-mentioned first embodiment, a prepaid balance is transmitted from the vehicle mount device 10 to the roadside device 5. The present invention is applicable for electronic money systems. In such case, a remaining amount of loaded money is transmitted to the roadside device 5.

#### [0021] (Second Embodiment)

Now, a second embodiment of the present invention will be described by referring to Fig. 2. In the second embodiment, a time measuring part 18 for outputting time data is added to the vehicle mount device 10 of the first embodiment shown in Fig. 1. Since other structures are the same as those of the first embodiment, the same components are designated by the same reference numerals and a duplicated explanation is omitted. Only an operation thereof will be described below.

[0022] In the second embodiment, when a control part 13 of a vehicle mount device 10 obtains a parking permission time from a roadside device 1, the control device reads a present timer value (for instance, time or a counter value for each second) from the time measuring part 18 such as a timer capable of measuring the time to compare the present timer value with the parking permission time. As a result of the comparison, when the parking permission time is larger than the timer value, the control part 13 continuously periodically reads a timer value from the time measuring part 18 and repeatedly compares the timer value with the parking permission time. When the control part 13 decides that the parking permission time is smaller than the timer value, the control part outputs an alarm message, for instance, "At present, a parking time is longer some minutes than the parking permission time." by either or both of a character display by display means 15 or an audio display by an audio synthesizing part 16 or a speaker 17.

[0023] In a parking place, the power of a vehicle is turned off when the vehicle is parked. Thus, when the control part 13 obtains the parking permission time from the roadside device 1, the control part reads the present timer value (for instance, the time or the counter value for each second) from the time measuring part 18 and records the present timer value in an inner memory of the control part 13. Then, the vehicle mount device 10 shifts to a standby state at a timing of turning off the power of the vehicle due to parking of the vehicle by a user.

Only the time measuring part 18 continuously operates by weak current (standby current). Then, when the user turns on the power of the vehicle for starting the vehicle, the vehicle mount device 10 is turned on and the control part 13 obtains the latest timer value from the time measuring part 18. The control part 13 calculates an elapse time from the timer value recorded in the inner memory when the control part obtains the parking permission time from the roadside device 1 and the latest timer value.

[0024] As a result of comparison, when a usable time is smaller than the elapse time, the control part 13 outputs an alarm message, for instance, "Balance is insufficient in your card." by the display part 15 and the audio synthesizing part 16 and the speaker 17. The control device previously receives a parking fee per time of the parking place from the roadside device 1 (as a timing of receiving the parking fee, the control device receives the parking fee at the same time as the receipt of the parking permission time at the entrance gate of the parking place.). The control part 13 calculates an excess of usable time by using an expression of "the excess of usable time = the elapse time - the usable time" and calculates an insufficient amount of money from the excess of usable time and the parking fee per time. For instance, the insufficient amount of money is expressed by the insufficient amount of money = the excess of usable time/the parking fee per time. Further, the control part 13 informs the user of the insufficient amount of money by either or both of the character display by the display part 15 or the audio display by the audio synthesizing part 16 and the speaker 17.

[0025] As described above, according to the second embodiment, the control part 13 stores the timer value when the control part receives the parking permission time from the roadside device 1. The control part calculates the elapse time from the timer value and the timer value when the power is turned on upon starting the vehicle after the vehicle is parked. When the elapse time is larger than the parking permission time, the control part informs the user of the excess of the parking time and the insufficient balance. Thus, the control part can previously inform the user that the present prepaid balance of an IC card is insufficient for the parking fee and an adjustment is necessary by cash.

[0026] According to the second embodiment, the elapse time is calculated from the timer value stored in the inner memory when the parking permission time is obtained from the roadside device 1 and the latest timer value. However, a timer value may be stored in the inner memory of the control part 13 when the power is turned off for parking the vehicle and the elapse time may be calculated from the timer value and the latest timer value when the power is turned on for starting the vehicle.

#### [0027] (Third Embodiment)

Now, a third embodiment of the present invention will be described by referring to Fig. 3. In the third embodiment, the time measuring part 18 shown in Fig. 2 is provided in an external part. Since other structures are the same

as those of the second embodiment, the same components are designated by the same reference numerals and a duplicated explanation will be omitted. An external time measuring part 19 is incorporated in, for instance, a navigation device mounted on a vehicle and utilizes a clock function such as a real time clock held in the navigation device or time information received from a GPS.

**[0028]** As described above, according to the third embodiment of the present invention, even when the time measuring part is not provided in a vehicle mount device 10, time data can be externally obtained. Thus, the structure of the vehicle mount device 10 can be simplified.

**[0029]** (Fourth Embodiment)

Now, a fourth embodiment of the present invention will be described by referring to Fig. 4. In the fourth embodiment, a roadside device 5 includes an antenna 6 capable of transmitting and receiving a radio wave between a portable telephone 21 held by a user of a vehicle mount device 10 and the antenna, a transmitting and receiving part 7 capable of communicating with the E mail address or the telephone number of the portable telephone 21, a control part 8 deciding whether or not a parking permission time calculated from prepaid balance received from the vehicle mount device 10 has passed and a time measuring part 9 for outputting time data. Further, a transmitting and receiving part 12 of the vehicle mount device 10 transmits the prepaid balance and the E mail address or the telephone number of the portable telephone 21 to the roadside device 5. Since other structures are the same as those of the first embodiment, the same components are designated by the same reference numerals and a duplicated explanation is omitted. Only an operation thereof will be described below.

**[0030]** A control part 13 of the vehicle mount device 10 reads the prepaid balance of an IC card 20 through a card interface 14 and reads the E mail address or the telephone number of the portable telephone 21 previously registered in the IC card by a user. Then, the control part controls the transmitting and receiving part 12 to transmit the data of the prepaid balance and the data of the E mail address or the telephone number to the roadside device 5 through an antenna 11. When the roadside device 5 receives the data of the prepaid balance and the data of the E mail address or the telephone number through the antenna 6, the control part 8 calculates the parking permission time in accordance with the prepaid balance on the basis of a parking fee per time of a parking place. Further, when the control part 8 calculates the parking permission time, the control part reads a present timer value a present timer value (for instance, time or a counter value for each second) from the time measuring part 9 such as a timer capable of measuring the time to compare the present timer value with the parking permission time. As a result of the comparison, when the parking permission time is larger than the timer value, the control part 8 continuously periodically reads a timer value from the time measuring part 9 and repeatedly compares the timer value with the parking permission time.

**[0031]** When the parking permission time is equal to the timer value + five minutes, that is, a parking time reaches five minutes before the parking permission time (This time can be arbitrarily set.), the control part 8 outputs a document message or an audio message previously stored in the inner memory of the control part 8, for instance, "Your parking time is five minutes before the parking permission time." by transmitting an E mail or a speech by the portable telephone 21. Further, when the parking permission time is equal to the timer value, the control part 8 outputs a document message or an audio message previously stored in the inner memory of the control part 8, for instance, "Your parking time has just exceeded the parking permission time." by transmitting an E mail or a speech by the portable telephone 21.

**[0032]** As described above, according to the fourth embodiment of the present invention, even when the user is present outside a vehicle, the user can know the lapse of the parking permission time in accordance with the present prepaid balance through the portable telephone 21. Thus, the user can be prevented from paying an excessive parking fee, because the user does not know the excess of the parking permission time.

**[0033]** In the fourth embodiment, the vehicle mount device 10 is explained as an example having no time measuring part for measuring the parking permission time like the first embodiment. However, the vehicle mount device 10 of this embodiment may have the time measuring part 18 similar to that of the second embodiment or the time measuring part 19 similar to that of the third embodiment. The second embodiment or the third embodiment may be combined with the fourth embodiment and the combination may be put into practice. Thus, even when the user is present inside or outside the vehicle, the user can know the lapse of the parking permission time and calculate an insufficient amount of money corresponding to an excess of time after the lapse of the parking permission time.

**[0034]** As described above, in the automatic parking fee receiving system according to the present invention, since the roadside device calculates the parking permission time from the prepaid balance sent from the vehicle mount device and transmits the parking permission time to the vehicle mount device. Accordingly, the user can advantageously previously understand the parking permission time from the present prepaid balance of the IC card. Thus, the present invention is useful for an automatic parking fee receiving system for adjusting a parking fee by a radio communication between the vehicle mount device using the IC card in which the prepaid balance is stored and the roadside device installed in the parking place.

## Claims

1. An automatic parking fee receiving system comprising:

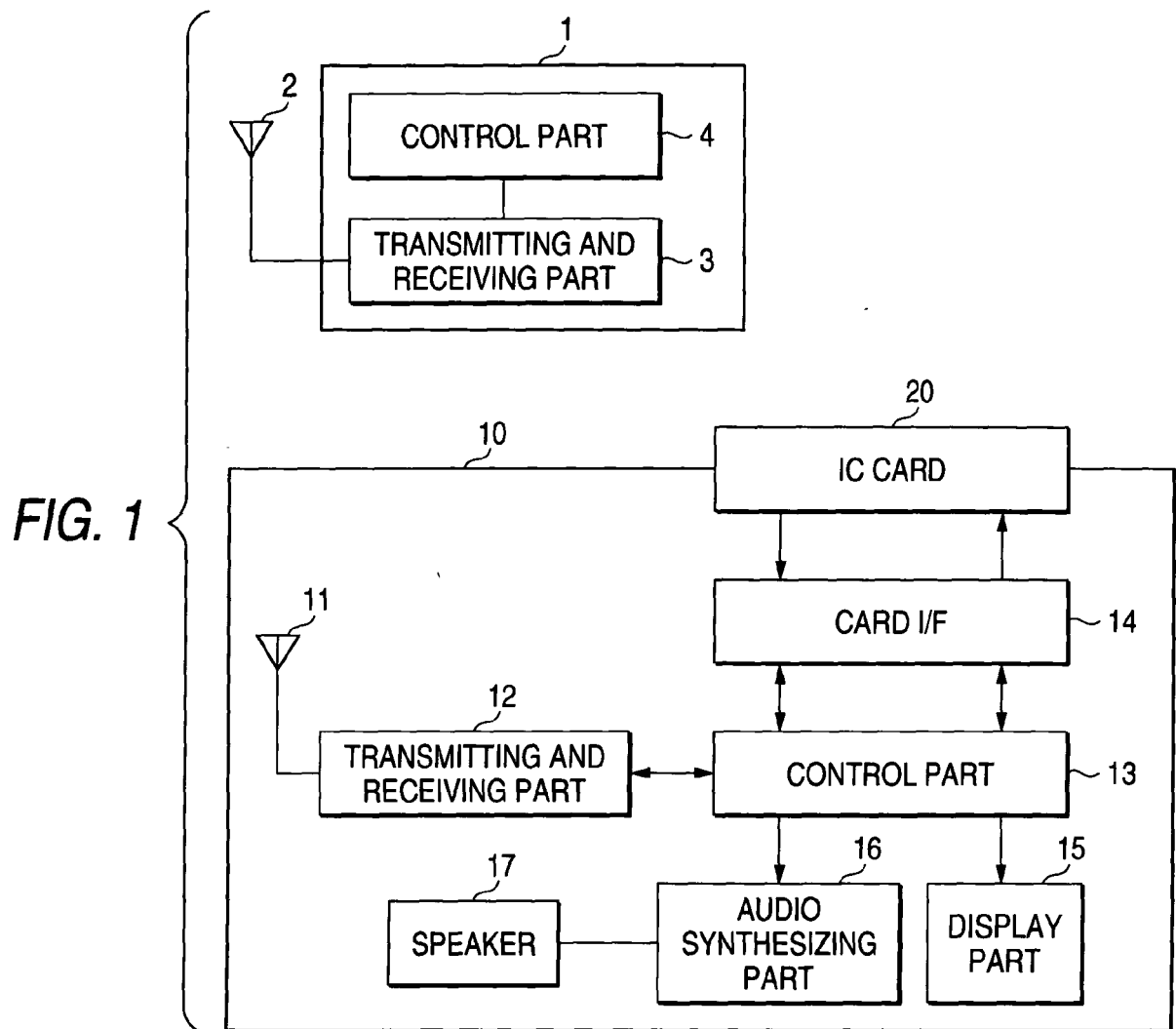
a roadside device for calculating a parking permission time from balance sent from a vehicle mount device and transmitting the parking permission time to the vehicle mount device; and the vehicle mount device including:

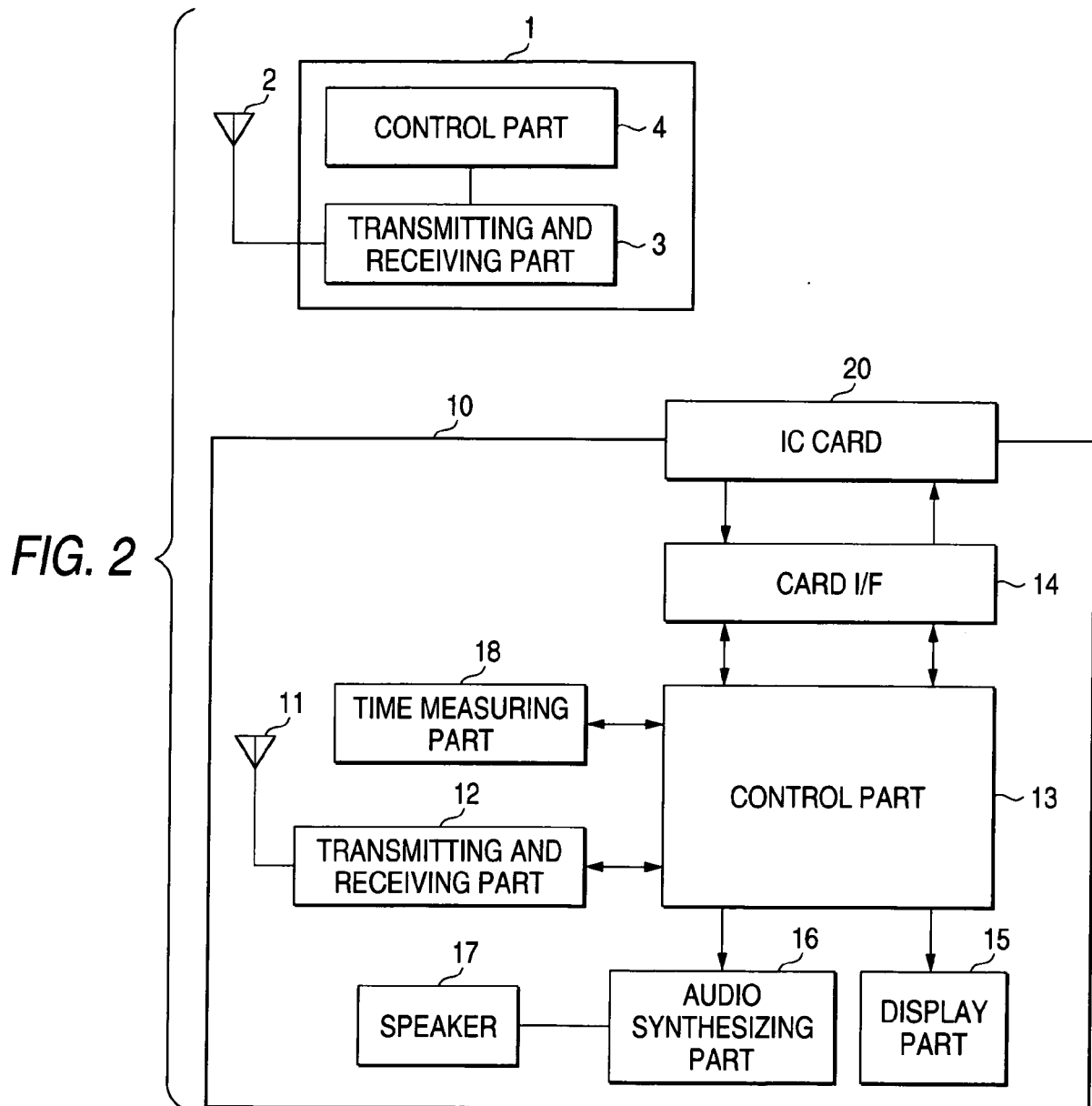
a transmitting and receiving unit for transmitting and receiving data between the roadside device and the vehicle mount device,  
a memory in which balance is stored,  
a card interface unit for reading and writing data on the memory,  
a control unit for transmitting the balance read from the memory to the roadside device through the transmitting and receiving unit and  
an informing unit for informing a user of the parking permission time received from the roadside device.

2. An automatic parking fee receiving system according to claim 1, wherein the informing unit informs the parking permission time by at least one of a display or an audio. 25
3. An automatic parking fee receiving system according to claim 1 or 2, wherein the vehicle mount device includes a time measuring unit for outputting time data, when the control unit fetches the time data from the time measuring unit and receives the parking permission time from the roadside device, the control unit calculates an elapse time from that time until departure and compares the parking permission time with the elapse time, and when the elapse time is longer than the parking permission time, the control unit alarms a user by the informing unit. 30 35
4. An automatic parking fee receiving system according to claim 3, wherein the control unit stores the time data from the time measuring unit when the control unit receives the parking permission time from the roadside device, and calculates the elapse time from the time data and time data when a power is turned on upon departure after parking. 40 45
5. An automatic parking fee receiving system according to claim 3 or 4, wherein the control unit calculates a deficient balance when the elapse time is longer than the parking permission time. 50
6. An automatic parking fee receiving system according to any of claims 3 to 5, wherein the time measuring unit is provided in an external device and the time data is obtained from the external device. 55
7. An automatic parking fee receiving system according to claim 6, wherein the external device is a nav-

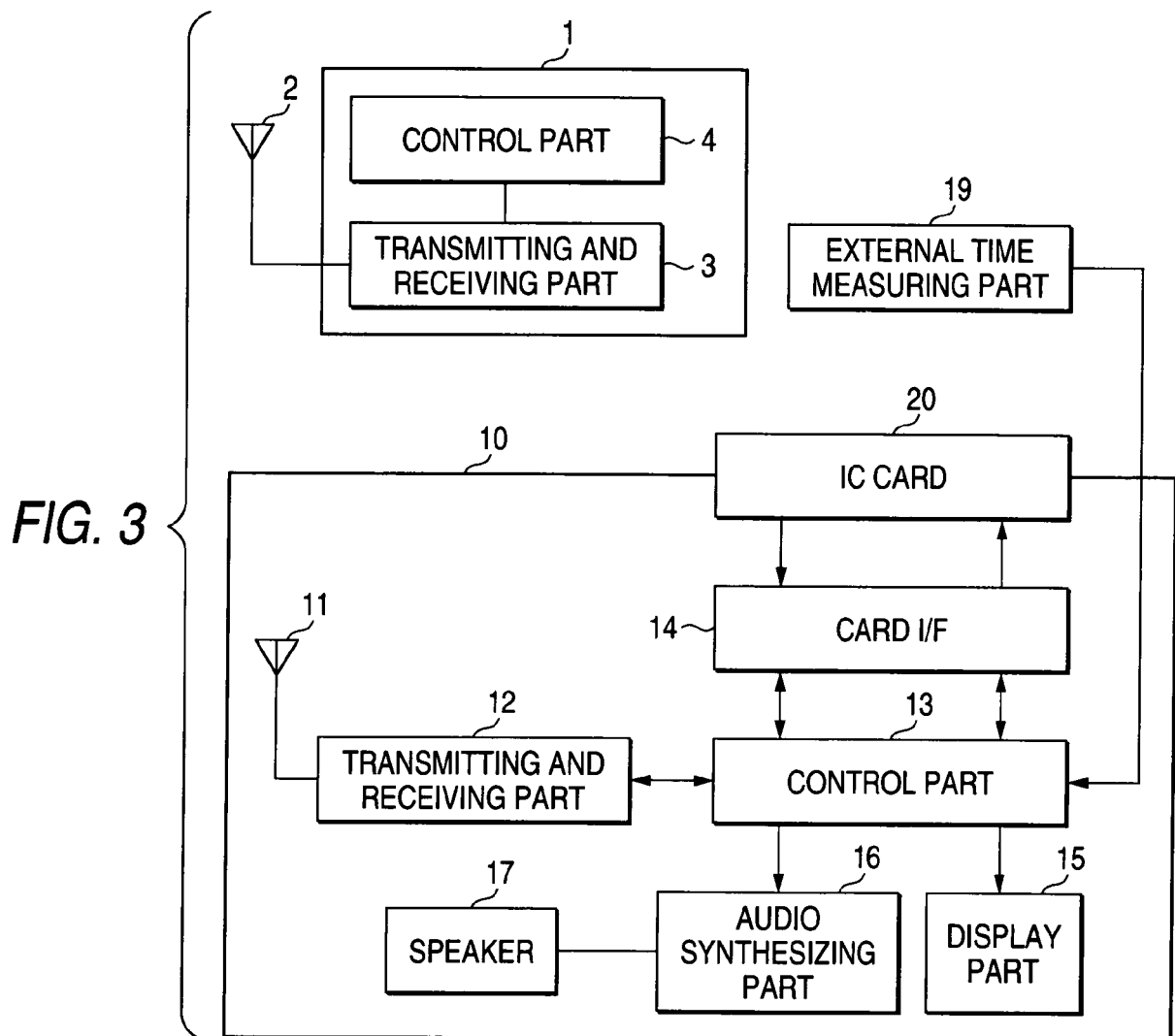
igation device.

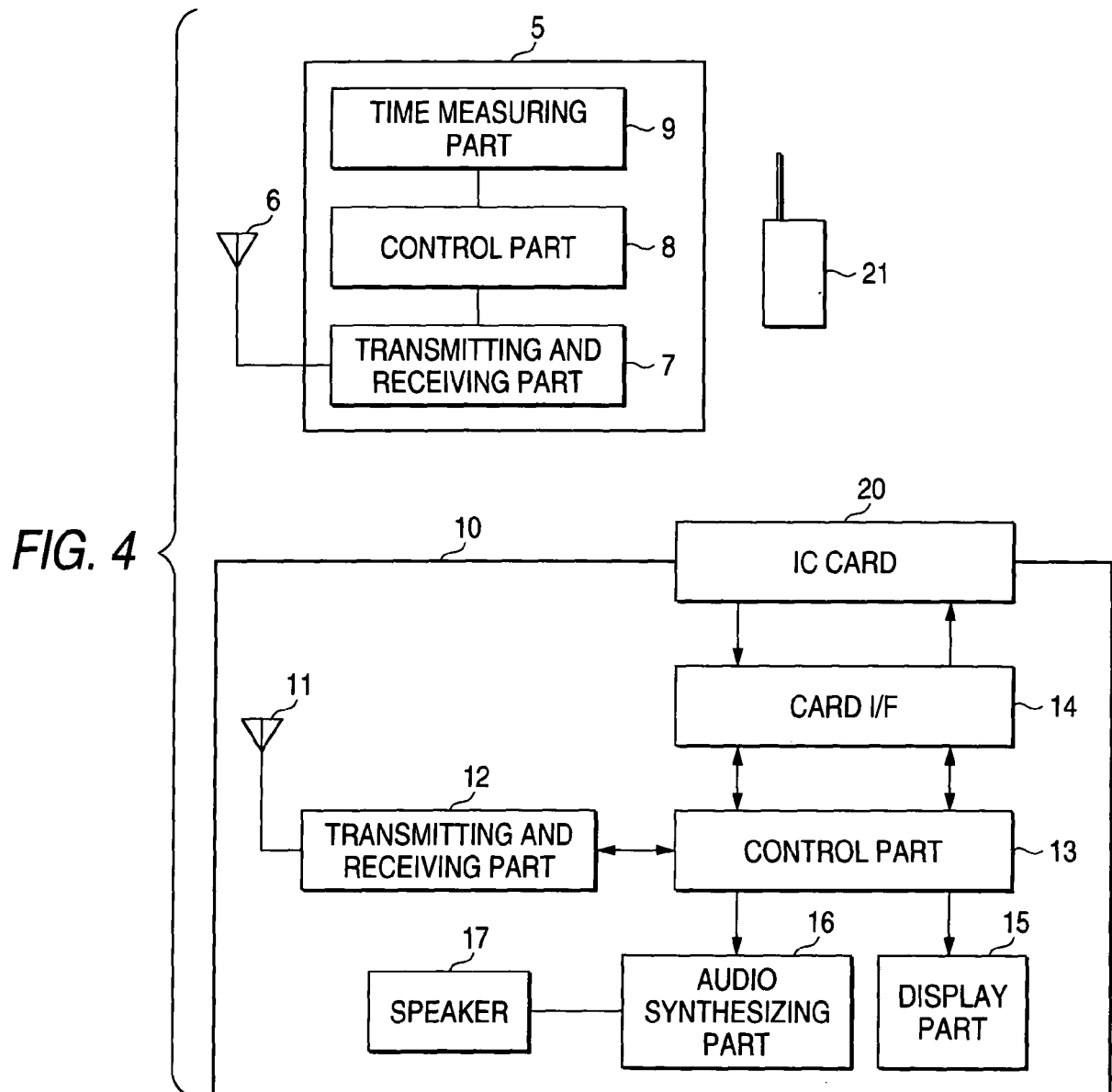
8. An automatic parking fee receiving system according to any one of claims 1 to 7, wherein the control unit transmits the E mail address or the telephone number of a portable telephone together with the balance to the roadside device and the roadside device informs the E mail address or the telephone number that the parking permission time passes or has passed before the calculated parking permission time passes or after the calculated parking permission time has passed.
9. An automatic parking fee receiving system according to claim 8, wherein the roadside device informs the E mail address or the telephone number of the lapse of the calculated parking permission time before a prescribed time of the lapse of the calculated parking permission time.
10. An automatic parking fee receiving system according to claim 1, wherein the memory is one of an IC card and flash memory device.













European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 04 02 2295

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 5 266 947 A (FUJIWARA HIDETOSHI ET AL) 30 November 1993 (1993-11-30) * column 1, lines 40-51; claim 1; figures 1-7 * * column 2, line 14 - column 6, line 19 * -----	1-10	G07B15/02 G07C1/30
X	EP 1 229 501 A (PARKING PARTNERS LTD) 7 August 2002 (2002-08-07) * paragraphs [0005] - [0009], [0035]; claims 1,2,5,7,8; figures 1,2 * -----	1-10	
X	EP 0 146 664 A (RACINE MARTIAL ; SCHAFFER RUDOLF (CH)) 3 July 1985 (1985-07-03) * claims 1-3; figure 1 * -----	1-10	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			G07C G07B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 4 January 2005	Examiner Höhn, M
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... &amp; : member of the same patent family, corresponding document</p>			

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 04 02 2295

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
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04-01-2005

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