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copy**A PARKING FEE MONITORING AND COLLECTION MEANS** ✓**FIELD OF THE INVENTION**

This invention relates to a parking fee monitoring and collection system.

According to one particular example the invention is able to be used with a
5 portable memory means such as smart card which can be used with an
electronic in-vehicle parking meter having a communication device.

BACKGROUND OF THE INVENTION

In providing parking for vehicles it is common for authorities or car park owners
to provide an open public car park that does not have entrance and exit barriers
10 but where a parking fee is payable for use of a parking bay. In such car parks
there are currently several different methods of collecting parking fees at such
open public car parks which include:

1. Parking Coupons

Car park owners or management organisations print parking coupons
15 where a motorist must buy parking coupons and when using the coupons
the motorist is required to estimate his parking time and display correctly
at least one coupon before parking according to the period of time
required. The coupon is required to be displayed in the car at an
appropriate place to allow car park wardens to check it visually. This
20 system suffers from several inconveniences which include :

(1a) The parking fee is based on the estimated parking time at a
minimum time unit (eg. 30 minutes). If the actual parking time used
is less than the estimated parking time, the motorist cannot be
refunded the overpaid fees. If the actual parking time is more than
25 the estimated time, the motorist is required to go back into the car,
and display additional coupons before the estimated time passes,
to avoid the risk of being fined.

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DATE OF RECEIPT		

(1b) The visual checking of displayed coupons by wardens is time consuming, which requires the support of a high cost operation and/or the imposition of high penalties in the event of an offence.

5 (1c) The use of a large quantity of paper in production of the coupons results in a waste of resources and can be the cause of environmental pollution.

2. Pay and Display Machines

10 A pay and display machine comprises a fixed ticket dispensing machine installed in the open public car parks for use by motorists. Before parking, a motorist has to estimate his parking time and input that time into the pay and display machine. The machine will then calculate and display the corresponding parking fee to be paid. The motorist pays the fee by feeding money into the meter and in turn receives a receipt from the machine. The motorist then displays the receipt in the vehicle for visual
15 inspection by wardens. While the use of the pay and display machine does provide the motorists with some conveniences (eg. the motorists do not need to buy coupons or display a number of coupons according to the anticipated parking period) the use of such machines still result in the three inconveniences described at (1a) to (1c) above.

20 An alternative form of car park comprises a closed car park where the entries and exits are associated with gates or booms where the gates or booms will be raised by a parking attendant who will deliver entry coupons on the entry of a vehicle into the car park and collect the parking fee on the departure of the vehicle from the car park or alternatively inspect a coupon or pass card. It is
25 also common for such closed car parks to be automatic whereby on entry of a car into a car park, a coupon is delivered to the driver by a machine prior to the gate or boom being opened and on departure of the vehicle the driver must present money or a prepaid coupon to a machine associated with the exit gate or boom. The parking fee collection and monitoring systems used with closed



car parks suffer from the same form of difficulty as has been described above in relation to open car parks.

OBJECT OF THE INVENTION

It is an object of the invention to at least partially overcome some of the above
5 mentioned difficulties of existing systems for monitoring and collecting parking fees.

SUMMARY OF THE INVENTION

Accordingly the invention resides in a parking fee monitoring and collection means comprising in combination at least a portable memory means; an in-
10 vehicle parking meter; an enforcement means; and a top-up means; the portable storage means having a first memory comprising a reloadable first store for carrying credit and a second store capable as serving as a carrier of car park data related to car park owners, previous transactions and car park pricing parameters; an in-vehicle parking meter having a second memory of a
15 corresponding form as the first memory, a processor, and a communication means, said processor being adapted to calculate a parking fee according to the car park pricing parameters and the particulars of the parking bay, the time of day, the day of the year and the parked time, to debit the parking fee from the memory device and said communication means being adapted to remotely
20 communicate with the enforcement means to provide credit data to the enforcement device; whereby the enforcement device is able to be used to remotely check the validity of the in-vehicle parking meter and to record and print parking offence notices; said top-up machine being adapted to transfer a credit to first store of the portable memory device, update the status of the car
25 park pricing parameters in the second store and obtain transaction from the portable memory device regarding previous transactions.

According to a preferred feature of the invention at least a portion of the memory of the portable memory device constitutes at least a portion of the memory of the in-vehicle parking meter.





According to a further preferred feature of the invention the in-vehicle parking meter also comprises an input means which is adapted to be able to communicate with the portable memory device to receive credit therefrom, update the car park pricing parameters and transfer the transaction data to the
5 portable memory means.

According to a further preferred feature of the invention the enforcement device further comprises a memory adapted to accommodate said car park pricing parameters; a clock providing date and time data; a keypad; a visual display; a processor; and a printer; said enforcement means being capable of receiving
10 information from the keypad regarding the particulars of a vehicle; storing said information and the credit data received by the communication means from the in-vehicle parking meter; said printer being able to print parking offence notices.

According to a further preferred feature of the invention said top-up machine comprises an input that is capable of transferring credit and car park data to the
15 portable memory means and transaction data from the in-vehicle parking meter ; a keyboard; a visual display; a processor.

According to another aspect of the invention the invention resides in a parking fee monitoring and collection means comprising an in-vehicle parking meter which includes an input means, a memory, a clock, a processor and a display
20 means, said clock providing timing and date details, said memory adapted to receive and store a credit value and to accommodate information relating to car park pricing parameters and car park particulars, said input being capable of inputting data regarding a parking event and to activate the processor, said input further comprising a reader adapted to be able to transfer information and
25 credit to and from a portable memory means to vary the credit value, said processor adapted to process said data according to said information and the timing and date details of the parking event, determine a fee for said parking event, deduct the fee from said credit value and transmit to the memory the particulars of the parking event which are stored as a transaction, said display
30 means comprising a visual display means providing time, timing and date details

and transaction details, said display means further comprising a communication means adapted to selectively provide an indication of the status of the credit value in the memory.

5 According to a preferred feature of the above aspect the parking fee monitoring and collection means further comprises said portable memory means, and a top-up means from which the portable memory device receives the credit and the information for use by the in-vehicle parking meter and to which the portable memory device passes previous transaction details.

10 According to a preferred feature the portable memory device provides at least a portion of the memory for the in-vehicle parking meter.

15 According to a preferred feature of the above aspect the parking fee monitoring and collection means further comprises an enforcement means having a communication means, an input, a processor, a memory, and a printer, said communication means adapted to communicate with the communication means of the in-vehicle parking meter, said input means adapted to receive information regarding the vehicle accommodating the in-vehicle parking meter, said processor adapted to determine an appropriate penalty relating to the parking event, to activate the printer to print a notice relating to the parking event, and pass the information to the memory.

20 According to a further preferred feature the memory of the enforcement means is adapted to accommodate said information and the communication means of the enforcement means is adapted to transmit said information to the in-vehicle parking meter.

25 According to a preferred feature of the above aspect the signal comprises an electromagnetic signal. According to one example the signal comprises an infrared signal.

According to an alternative preferred feature of the invention the portable memory means comprises a smart card.

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Throughout this specification the term portable memory device shall be taken as including a smart card (self-protected memory card or micro-processor card) or equivalent device which is able to be used to transfer information between installations and which has a means to enable the information to be transferred
5 which means can include a machine readable interface or a transmitter and receiver of electro-magnetic radiation such as infrared radiation, and which are capable of transferring encoded data to and from the device.

According to a further preferred feature of the invention the in-vehicle parking meter is provided with an activation means which is able to activate and
10 deactivate the in-vehicle parking meter to initiate and terminate respectively a parking transaction. According to one embodiment the activation means comprises a control associated with the in-vehicle parking meter and which is adapted to be operated manually. According to another embodiment the
15 activation means comprises a control associated with a car park which will cause activation and deactivation of the in-vehicle parking meter on the entry and the departure from the car park respectively of the vehicle housing the in-vehicle parking meter.

DESCRIPTION OF EMBODIMENTS OF THE INVENTION

The invention will be more fully understood in the light of the following
20 description of several specific embodiments. The description is made with reference to the accompanying drawings of which:

Figure 1 which is a schematic representation of a parking fee monitoring system for open public car parks according to the first embodiment;

Figure 2 illustrates the display and the in-vehicle parking meter according to the
25 first embodiment;

Figure 3 illustrates the enforcement device and the interconnection between the elements of the enforcement device according to the first embodiment;



Figure 4 illustrates the display and the interconnection between the elements of the top-up machine according to the first embodiment;

Figure 5 illustrates the interface screen of the top-up machine for selecting the top-up amount according to the first embodiment;

- 5 Figure 6 illustrates the interface screen of the top-up machine displaying the result of a top-up operation according to the first embodiment;

Figure 7 to Figure 10 illustrate some display screens of a management station which is connected to the top-up machine by a network for management of the car park pricing parameters by a relevant authority according to the first
10 embodiment;

Figure 11 illustrates the display of a computer connected to the top-up machines by network for settlement according to the first embodiment; and

Figure 12 which is a schematic representation of a parking fee monitoring system for closed public car parks according to the second embodiment.

- 15 The open public car park parking fee monitoring system, according to the first embodiment as illustrated schematically at in Figure 1 is intended for use in an open car park and, comprises in combination a portable memory means which takes the form of a "smart card" (1) functioning both as a reloadable stored value card (or chip) and as a carrier of the data related to the identity of the vehicle
20 owner, the car park owner and to the car park pricing parameters; and an in-vehicle parking meter (2) that has a microprocessor and an infrared communication device where the in-vehicle parking meter (2) is used to calculate the parking fee, to debit the fee from the smart card (1) and to communicate with an enforcement device (3) which also forms part of the
25 combination and which is to be used by car park wardens to check the validity of parking meters and to record and print parking offence notices. The embodiment further comprises a top-up machine (4) for replenishing the smart card, for collecting the necessary information regarding previous transactions for





settlement purpose, and also for updating car park pricing parameters in the in-vehicle parking meter through the smart card (1).

As stated above the form of portable memory device used in the first embodiment comprises a smart card which is an IC card with either a self-protected memory or a microprocessor in the IC chip and which is a portable
5 digital data carrier with high security due to its specially designed protection logic circuit, security code, and/or cryptographic keys, encryption and authentication algorithms.

The smart card used in the embodiment has two roles :

- 10 (a) a reloadable stored value media for providing credit to the in-vehicle parking meter where the prepaid credit is stored in the card and deducted by the parking meter according to parking rate and parked time.
- 15 (b) a carrier of data related to the owner of the vehicle, the owner of the parking place (bucket) and to the car park pricing parameters. In regard to the bucket, a car park owner's bucket is a memory zone assigned to a car park owner and is used to accumulate the charged parking fee of previous parking transactions that belong to the owner of the parking place. When the card is being
20 replenished, the amount in the bucket relating to previous transactions will be transferred into a corresponding "pool" provided in the top-up-machine for settlement purpose.

The car park pricing parameters include the parking rate related to a parking zone, the date and time; time unit of charging; beginning and end points of time
25 zones, etc. These parameters are set by the car park owner or by the relevant authority and are subject to modification as and when the need arises. The parameters are stored in the top-up machine and any variations are transferred into the smart card during top-up operation to be transferred to the in-vehicle parking meter when the card is inserted into the in-vehicle parking meter .



The smart card used in the embodiment can be a special parking card or a general purpose cash card with a special parking fee file.

The in-vehicle parking meter (2) of the embodiment comprises a smart card pricing terminal which can if desired be the size of a pocket calculator and is to be placed on the dashboard of the vehicle. The parking meter (2) has a first memory accommodating information in regard to the parking tariffs according to the parking zones available to the motorist, the parking time, the time of day and particular days of the year, a clock and a processor which is able to calculate the parking fee payable based on the parking rate, the parked time, the time of day and the particular day of the year. In addition the in-vehicle parking meter has an input which is adapted to receive the smart card to access the memory contained in the card in regard to the credit available in the card and the parking tariff parameters. The processor is able to deduct the parking fee from credit stored in the smart card provided the smart card has been installed in the input. The credit which is deducted at each parking transaction is in turn recorded in the bucket in the smart card in order to identify the party (ie parking place owner) to whom the credit is to be credited when the smart card is again topped up from the top-up machine. In addition, if on installing the smart card the parking tariff parameters have changed, the memory in the in-vehicle parking meter will be upgraded accordingly.

On parking the vehicle at a parking place, a motorist inputs into the in-vehicle parking meter, the relevant code for parking zone by using the cursor buttons (5) and the LCD (6) which also displays other pertinent information such as date, time, the balance of credit available in the smart card, parking fee, etc. As stated the memory in the in-vehicle parking meter includes the parking pricing table (8) set by relevant authority. The pricing table contains car park pricing parameters such as parking rates, zone, date and time. The pricing parameters in the table can be modified by the authority when it is necessary. The new pricing parameters are stored in the top-up machines and transferred into the in-vehicle parking meter through the smart cards. The clock (9) is used to provide real time clock and calendar functions and is linked to the processor. The input



comprises a smart card reader/writer (10) for the reading and writing of the card. In addition the in-vehicle parking meter incorporates a display means which comprises a transmitter and receiver in the form of an infrared communication device (7) which is able to receive the query signal and the time calibration information from the enforcement device (3), and transmit the meter status including the credit status of the smart card to the enforcement device for validity checking. The processor (11) is programmed to find the actual parking rate from the pricing table according to the parking zone being occupied, the date, and the time of day, the day of the year in order to calculate the parking fee, and to perform debit transaction control, parameter transfer control, communication, security and other functions.

The enforcement device (3) as shown at Figure 3 is used by car park wardens for checking the in-vehicle parking meter validity, the status of the credit stored by the smart card, calibrating the time clock in the in-vehicle parking meter (when necessary), and dealing with parking offences. The verification of the validity of the in-vehicle parking meter includes the checking of the parameters received from the meter through infrared communication, such as security code, date, time, parking zone, pricing rate, etc. Once a warden presses the checking button of the enforcement device, an infrared query signal is sent to the parking meter to be checked. The meter will respond by returning its status and working parameters. If there is a small time difference between the time clock of the meter and that of the enforcement device, the enforcement device will send a time calibration information package to the meter to correct its real time clock. If any error in the meter is detected, the enforcement device asks the warden to input the car registration number, and then it will print a problem or offence notice. The enforcement device also allows the warden to input the parking place errors, such as parking in places other than in a parking lot, failing to obey signals, and etc., and to print the parking offence notices. The parking offence records stored in the enforcement device can subsequently be downloaded to a management station when the warden returns to the office. The enforcement device has an alphanumeric keypad (13) and a LCD display (14) which allows

the warden to input the relevant car parking zone, to start the in-vehicle parking meter checking, to input car registration numbers, the parking place, error codes, etc. An infrared communication device (15) is used for exchanging information with the in-vehicle parking meter. A small printer (16) is used to
5 print parking offence notices. The same car park pricing table (8) as that in the in-vehicle parking meter is stored in a non-volatile memory. A real time clock (17) provides date and time data. The enforcement means is provided with a microprocessor (18) and its related IC chips and software (19) which are used for the checking the validity of the in-vehicle parking meter, for calibrating the
10 time clock of the meters, and for performing other functions such as keypad control, print control, communication control, etc.

The top-up machine shown at Figure 4 is used to replenish the credit in the smart card, to update the car park pricing parameters stored in the card, and to deal with the operations related to parking fee settlement. The top-up machine
15 can either be a machine specially designed for the parking fee monitoring system use only or may comprise an Automatic Teller Machine (ATM) in which the necessary hardware and software for the parking fee monitoring system has been integrated. The top-up machine comprises a smart card reader/writer (20) which is used for reading and writing the smart card; a monitor (or display) (21),
20 a keyboard (22); a printer (23) for producing receipts; and a microprocessor based processing device (24) including a software (25) for performing the functions of:

- (a) smart card top-up (loading a credit into the purse file in the smart card chip by an exchange of money or a bank account transaction);
- 25 (b) management of car park pricing parameters (accept new parameters set by relevant authority; transfer the new parameters to smart card chips).
- (c) settlement which involves the extraction of the parking fees charged for previous transactions from the portion of the memory in the smart

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card relevant to the bucket of the parking place owner, and the transfer of the amount to the corresponding owner's account.

Figures 5 and 6 illustrate two interface screens of the top-up machine for the card top-up operation. By using the screen in Figure 5, a motorist can choose the amount that he would like to transfer to the smart card. The screen in Figure 6, shows the balance in the smart card before top-up, top-up amount and the new balance in the smart card. If desired the motorist can choose to obtain a print-out of the top-up receipt.

Figures 7 to 10 illustrate some sample screens of a management station which is connected to the top-up machines by a network for updating car park pricing parameters by the relevant authority. The screen in Figure 7 is intended for selecting the parameters for updating. The screen in Figure 8 allows for modification of the basic parking rates. The screen shown at Figure 9 is used to set the pricing parameters for one car park zone where the parameters include car park owner; car park zone number; pricing schedules for week days, Saturday, Sunday and holidays; and whole day limit. The screen in Figure 10 is intended for setting holiday dates.

Figure 11 illustrates the screen of a computer connected to the top-up machines by network for settlement processing.

In the case of the first embodiment as described above and as shown in the drawings the smart card provides the store for the credit which is to be consumed by the in-vehicle parking meter. According to an alternative embodiment the in-vehicle parking meter may have its own memory for storage of the credit in which case the input is able to transfer credit from the smart card to the memory of the in-vehicle parking meter.

The second embodiment which is schematically illustrated at Figure 12 is of a very similar form to the first embodiment is intended for use in association with a closed car park where the entries and exits are controlled by gates or booms (26) which are each associated with a barrier controller (28). In the case of the

second embodiment each barrier controller is provided with a scanner (27) which can be mounted on the gate or boom or the support therefor and which is able to communicate with the in-vehicle parking meter (2) of a vehicle as it approaches the gate or boom (26). Such communication in the case of the second
5 embodiment is effected by an encoded infrared signal.

The scanner associated with an entry to the car park communicates with the in-vehicle parking meter of an incoming vehicle to ensure that it has sufficient credit stored in the memory and if there is sufficient credit to activate the in-vehicle parking meter and open the gate or boom.

10 The scanner associated with the exit of the car park communicates with an exiting vehicle to deactivate the in-vehicle parking meter check. At this point in time the processor of the in-vehicle parking meter will determine the parking fee payable and deduct that fee from the credit stored in the memory. If at the conclusion of the transaction, the in-vehicle parking meter has sufficient credit stored in the memory the
15 controller (28) will open the gate or boom (26).

According to a further embodiment the smart card may provide the memory for the in-vehicle parking meter in relation to the parking parameters as well as the credit balance wherein the smart card must be installed in the input to provide the memory for the in-vehicle parking meter.

20 According to a further embodiment the in-vehicle parking meter may be self contained in regard to the memory functions of the smart card of the first embodiment. In such a case the transfer of information to and from the in-vehicle parking meter is effected through a separate portable memory means which is able to perform all of the functions of the smart card referred to above
25 but which is able to communicate with the in-vehicle parking meter and the top-up machine by means of an encoded signal in order to load the in-vehicle parking meter with credit and the parking parameters and to extract from the in-vehicle parking meter, the particulars regarding the consumption of credit and the relevant bucket to which the consumed credit is to be credited. The signal
30 may comprise any desired form of remote transmission. A particular example comprises infrared radiation.



It should be appreciated that the scope of the present invention need not be limited to the particular scope of the embodiments described above.

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The claims defining the invention are as follows:

1. A parking fee monitoring and collection means comprising in combination at least a portable memory means; an in-vehicle parking meter; an enforcement means; and a top-up means; the portable storage means having a first
5 memory comprising a reloadable first store for carrying credit and a second store capable as serving as a carrier of the data related to car park owners, previous transactions and car park pricing parameters; an in-vehicle parking meter having a second memory of a corresponding form as the first memory, a processor, and a communication means, said processor being adapted to
10 calculate a parking fee according to the car park pricing parameters and the particulars of the parking bay, the time of day, the day of the year and the parked time, to debit the parking fee from the memory device and said communication means being adapted to remotely communicate with the enforcement means to provide credit to the enforcement means; whereby the
15 enforcement means is able to be used to remotely check the validity of in-vehicle parking meter and to record and print parking offence notices; said top-up machine being adapted to transfer a credit to first store of the portable memory device, update the status of the car park pricing parameters in the second store and obtain transaction data necessary from the portable memory
20 device regarding previous transactions.
2. A parking fee monitoring and collection means as claimed at claim 1 wherein at least a portion of the memory of the portable memory device constitutes at least a portion of the memory of the in-vehicle parking meter.
3. A parking fee monitoring and collection means as claimed at claim 1 wherein
25 the in-vehicle parking meter also comprises an input means which is adapted to be able to communicate with the portable memory device to receive credit therefrom, update the car park pricing parameters and transfer data regarding previous transactions to the portable memory means.





4. A parking fee monitoring and collection means as claimed at any one of the preceding claims wherein the enforcement device further comprises a memory adapted to accommodate said car park pricing parameters; a clock providing date and time data; a keypad; a visual display; a processor; and a printer;
- 5 said enforcement means being capable of receiving information from the keypad regarding the particulars of a vehicle; storing said information and the data received by the communication means from the in-vehicle parking meter; said printer being able to print parking offence.
- 10 5. A parking fee monitoring and collection means as claimed at any one of the preceding claims wherein said top-up machine comprises an input that is capable of transferring data to and from the portable memory means; a keyboard; a visual display; a processor.
- 15 6. A parking fee monitoring and collection means as claimed at any one of the preceding claims wherein the portable memory means comprises a smart card.
7. A parking fee monitoring and collection means as claimed at any one of claims 1 to 5 wherein the portable memory means is able to communicate with the in-vehicle parking meter and the top-up machine by means of an encoded signal.
- 20 8. A parking fee monitoring and collection means as claimed at claim 7 wherein the signal comprises an electromagnetic signal.
9. A parking fee monitoring and collection means as claimed at claim 8 wherein the signal comprises an infrared signal.
- 25 10. A parking fee monitoring and collection means comprising an in-vehicle parking meter which includes an input means, a memory, a clock, a processor and a display means, said clock providing timing and date details, said memory adapted to receive and store a credit value and to accommodate information relating to car park pricing parameters and car park particulars,





- 5 said input comprising a keypad for inputting data regarding a parking event and to activate the processor, said input further comprising a reader adapted to be able to transfer information and credit to and from a portable memory means to vary the credit value, said processor adapted to process said data according to said information and the timing and date details of the parking event, determine a fee for said parking event, deduct the fee from said credit value and transmit to the memory the particulars of the parking event which are stored as a transaction, said display means comprising a visual display means providing time, timing and date details and transaction details, said display means further comprising a communication means adapted to selectively provide an indication of the status of the credit value in the memory.
- 10
11. A parking fee monitoring and collection means as claimed at claim 10 further comprising said portable memory means, and a top-up means from which the portable memory device receives the credit and the information for use by the in-vehicle parking meter and to which the portable memory device passes previous transaction details.
- 15
12. A parking fee monitoring and collection means as claimed at claim 11 wherein the portable memory device provides at least a portion of the memory for the in-vehicle parking meter.
- 20
13. A parking fee monitoring and collection means as claimed at any one of the claims 10 to 12 and further comprising an enforcement means having a communication means, an input, a processor, a memory, and a printer, said communication means adapted to communicate with the communication means of the in-vehicle parking meter, said input means adapted to receive information regarding the vehicle accommodating the in-vehicle parking meter, said processor adapted to determine an appropriate penalty relating to the parking event, to activate the printer to print a notice relating to the parking event, and pass the information to the memory.
- 25





- 14.A parking fee monitoring and collection means as claimed at claim 13 wherein the memory of the enforcement means is adapted to accommodate said information and the communication means of the enforcement means is adapted to transmit said information to the in-vehicle parking meter.
- 5 15.A parking fee monitoring and collection means as claimed at any one of the claims 10 to 14 wherein the portable memory means comprises a smart card.
- 16.A parking fee monitoring and collection means as claimed at any one of claims 10 to 14 wherein the portable memory means is able to communicate with the in-vehicle parking meter and the top-up machine by means of an
10 encoded signal.
- 17.A parking fee monitoring and collection means as claimed at claim 16 wherein the signal comprises an electromagnetic signal.
- 18.A parking fee monitoring and collection means as claimed at claim 17 wherein the signal comprises an infrared signal.
- 15 19.A parking fee monitoring and collection means as claimed at any one of the preceding claims wherein the in-vehicle parking meter is provided with an activation means which is able to activate and deactivate the in-vehicle parking meter to initiate and terminate respectively a parking transaction.
- 20 20.A parking fee monitoring and collection means as claimed at claim 19 wherein the activation means comprises a control associated with the in-vehicle parking meter and which is adapted to be operated manually.
- 21.A parking fee monitoring and collection means as claimed at claim 19 wherein the activation means comprises a control associated with a car park which will cause activation and deactivation of the in-vehicle parking meter on
25 the entry and the departure from the car park respectively of the vehicle housing the in-vehicle parking meter.
- 22.A parking fee monitoring and collection means substantially as herein described with reference to the accompanying drawings.



ABSTRACT

A PARKING FEE MONITORING AND COLLECTION MEANS

A parking fee monitoring and collection means comprising an in-vehicle parking meter (2) which can be associated with a portable memory means (1); an enforcement means (3); and a top-up means (4); the portable storage means (1) having a first memory adapted to store a credit value and also adapted to store data related to car park owners, previous transactions and car park pricing parameters; the in-vehicle parking meter (2) having a second memory (8) of a corresponding form as the first memory, a processor (11), and a communication means (7); the processor being adapted to calculate a parking fee according to the car park pricing parameters and the particulars of the parking bay, the time of day, the day of the year and the parked time, to debit the parking fee from the memory device; said communication means being adapted to remotely communicate with the enforcement means to provide data to the enforcement means; whereby the enforcement means is able to be used to remotely check the validity of in-vehicle parking meter and to record and print parking offence notices; the top-up machine being adapted to transfer a credit to the first memory device, update the status of the car park pricing parameters in the first memory and obtain transaction data necessary from the portable memory device regarding previous transactions.

Figure 1

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DRAWINGS

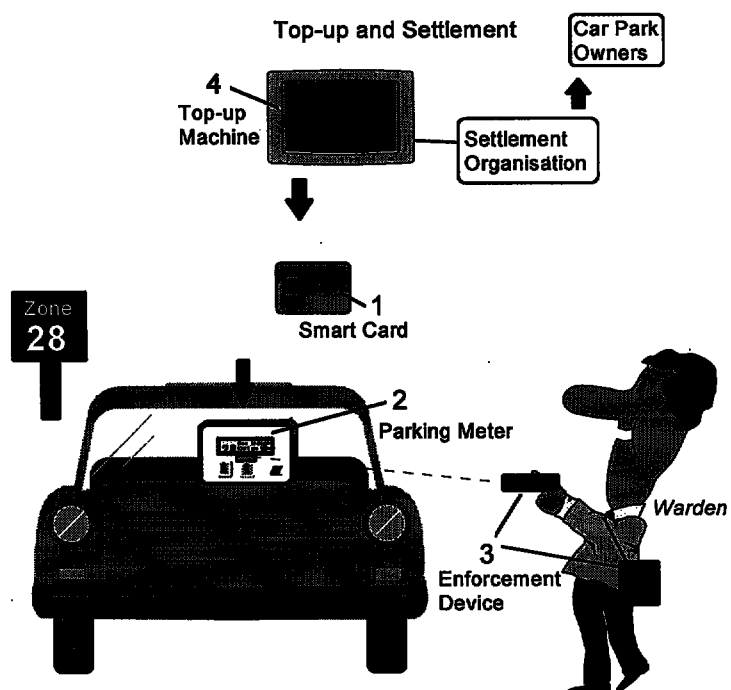


Figure 1

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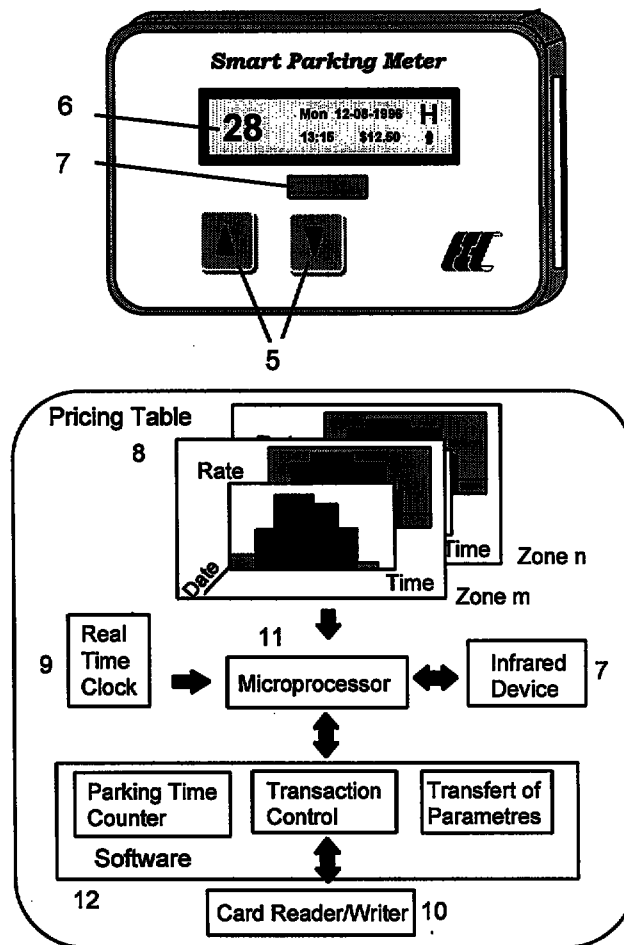


Figure 2

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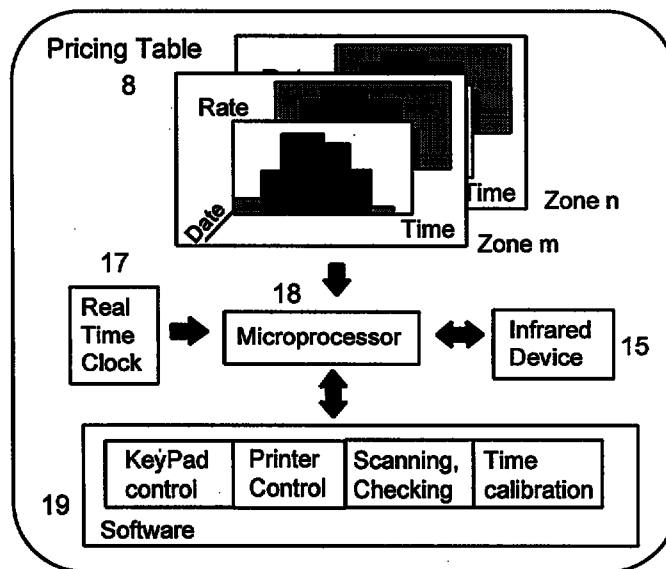
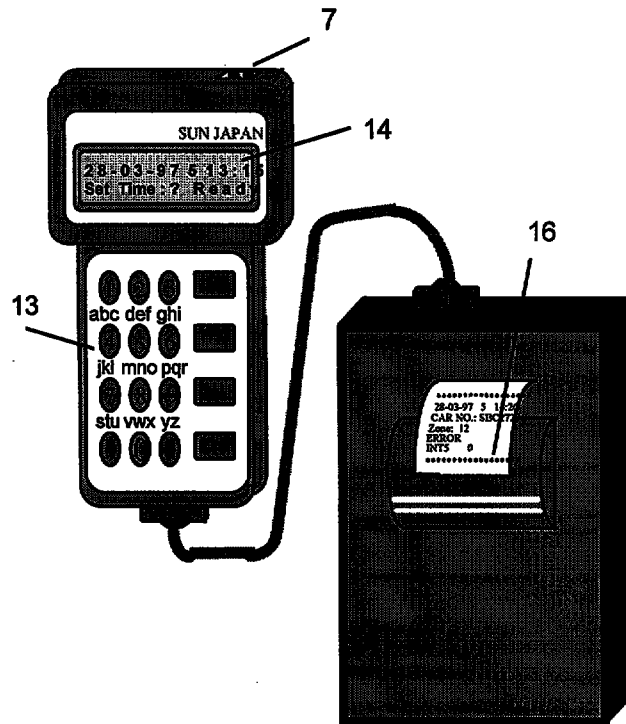


Figure 3

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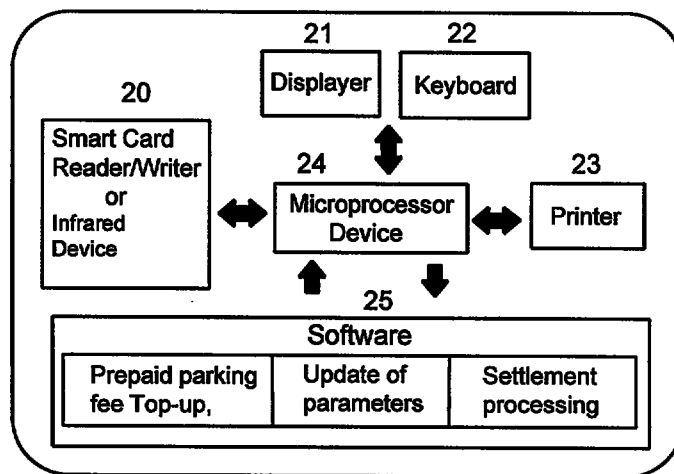
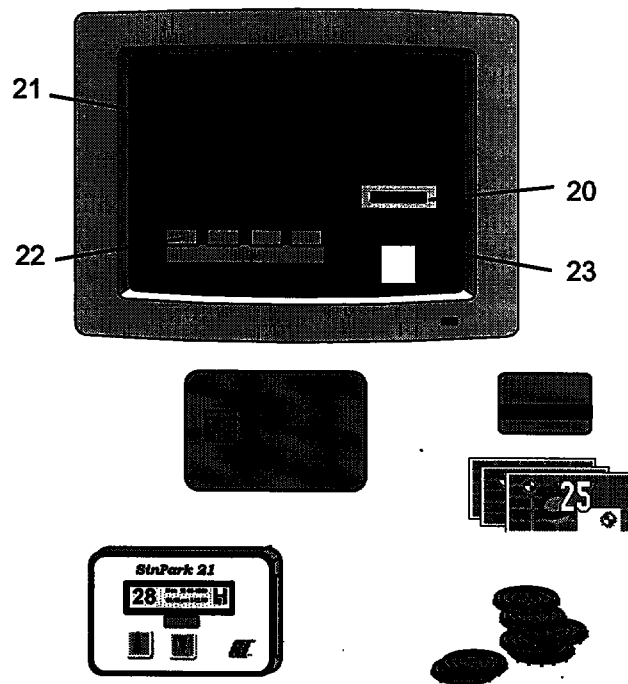


Figure 4

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Figure 5

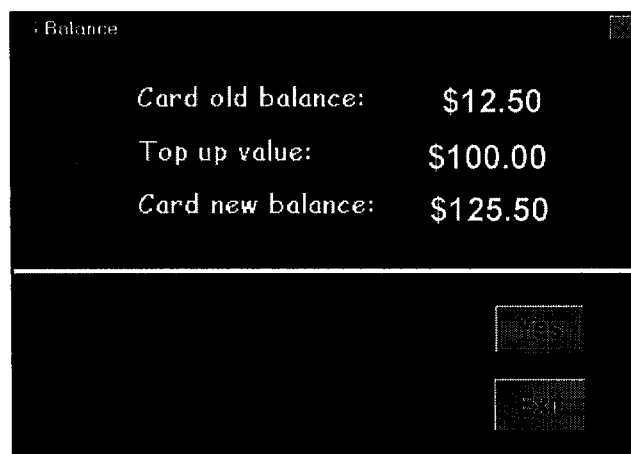


Figure 6

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Modify Parameter

Parameter	Ex Rate Time
What's the Rate	What's the Unit
Enter the Rate	

Cancel

Figure 7

Modify Parking Rate

1 31/12/1998

\$0.45	\$2.00
\$0.90	\$4.00
\$1.35	
\$1.80	

OK Cancel

Figure 8

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Untitled

HDB 3

\$0.90/30min	\$0.90/30min	\$0.45/30min
\$0.45/30min	\$0.45/30min	\$0.00
\$0.00	\$0.00	\$0.00

OK Cancel

Figure 9

Public Holidays Table Definition

Variable Holiday

Chinese New Year:	07/02/1997	07/02/1997
Hari Raya Puasa:	09/02/1997	07/05/1997
Good Friday:	28/03/1997	09/08/1997
Hari Raya Haji:	18/04/1997	25/07/1997
Vesak Day:	21/05/1997	
Deepavali:	31/12/1997	
Special Holiday:	00/00/0000	

OK Cancel

Figure 10

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Parking fee for owners	
Owner 1:	\$12.50
Owner 2:	\$36.80
Total accumulated parking fees:	
Owner 1:	\$1254.50
Owner 2:	\$2680.50

Figure 11

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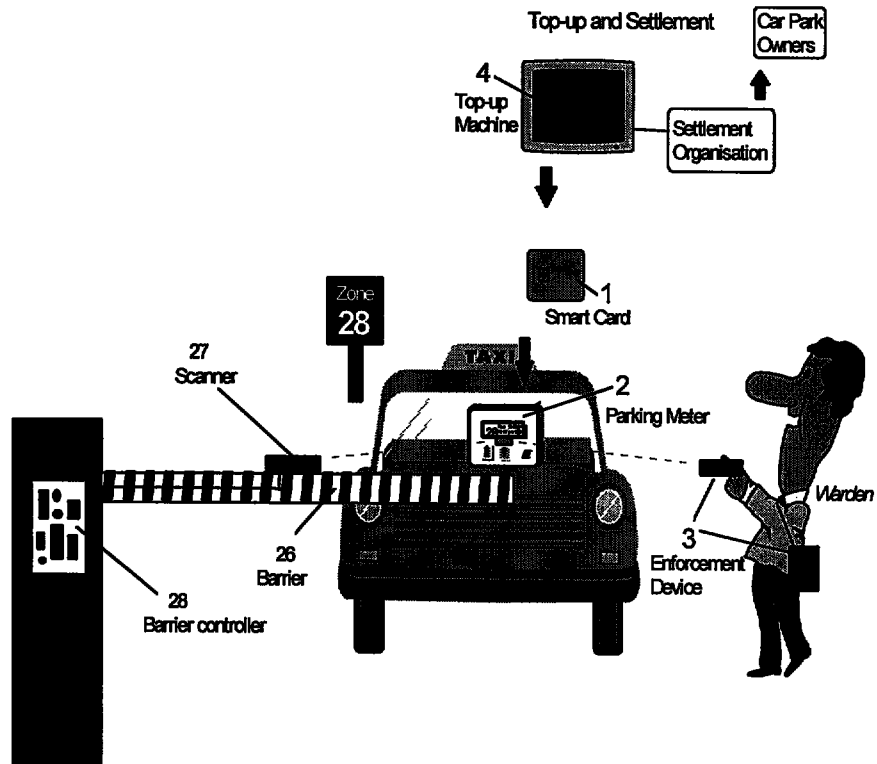


Figure 12

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A PARKING FEE MONITORING AND COLLECTION SYSTEM

FIELD OF THE INVENTION

This invention relates to a parking fee monitoring and collection system using
5 smart card as secure portable memory and electronic in-vehicle parking meter
with Infrared communication device.

BACKGROUND OF THE INVENTION

In providing parking for vehicles it is common for authorities or car park owners
to provide an open public car park that does not have entrance and exit barriers
10 but where a parking fee is payable for use of a parking bay. In such car parks
there are currently several different methods of collecting parking fees at such
open public car parks, which include:

1. Parking Coupons

Car park owners or management organizations print parking coupons
15 where a motorist must buy parking coupons and when using the coupons
the motorist is required to estimate his parking time and display correctly
at least one coupon before parking according to the period of time
required. The coupon is required to be displayed in the car at an
appropriate place to allow car park wardens to check it visually. This
20 system suffers from several inconveniences, which include:

(1a) The parking fee is based on the estimated parking time at a
minimum time unit (eg. 30 minutes). If the actual parking time used
is less than the estimated parking time, the motorist cannot be
refunded the overpaid fees. If the actual parking time is more than
25 the estimated time, the motorist is required to go back into the car,
and display additional coupons before the estimated time passes,
to avoid the risk of being fined.

REPLACEMENT SHEETS		SG
☒	Description : paged 1 to paged 14.	
☒	Claim(s) : paged 15 to paged 17.	
☒	Drawing(s) : paged 1/5 to paged 5/5	
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(1b) The visual checking of displayed coupons by wardens is time consuming, which requires the support of a high cost operation and/or the imposition of high penalties in the event of an offence.

5 (1c) The use of a large quantity of paper in production of the coupons results in a waste of resources and can be the cause of environmental pollution.

2. Pay and Display Machines

10 A pay and display machine comprises a fixed ticket dispensing machine installed in the open public car parks for use by motorists. Before parking, a motorist has to estimate his parking time and input that time into the pay and display machine. The machine will then calculate and display the corresponding parking fee to be paid. The motorist pays the fee by feeding money into the meter and in turn receives a receipt from the machine. The motorist then displays the receipt in the vehicle for visual inspection by wardens. While the use of the pay and display machine does provide the motorists with some conveniences (e.g. the motorists do not need to buy coupons or display a number of coupons according to the anticipated parking period) the use of such machines still result in the three inconveniences described at (1a) to (1c) above.

20 3. In-vehicle Electronic Parking Meters

25 Different electronic parking meters have been disclosed, such as U.S. Patent No. 4,730,285 and Israel Patent Nos. 72802 and 76111. Their common features include an electronic parking meter that has a memory for storing prepaid parking credit/time, an interface (buttons or switches) for starting/stopping the metering, a timer for measuring the parked time, and a display for indicating the available (balance of) credit/time eventually checked by car park wardens. The electronic parking meter disclosed by U.S. Patent no. 4,730,285 has zone selection features that allow the meter to be used for different parking zones with different charging rates.

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One of the major drawbacks of the electronic parking meters comes from the visual checking of meters.

4. Electronic Parking Tag/Meter with RF Communication Devices

European patent EP 0523742A2 (EASY PARK LTD) discloses a system for monitoring parked vehicles, comprising a portable parking tag for each vehicle and a reading device used by wardens. The portable parking tag uses a memory for storing parking parameters and pre-purchased credit. The credit in the tag is decreased in respect of actual parked time and zone. The parking tag uses a RF (radio frequency) communication device (a non-contact data communication circuit coupled with an antenna) for effecting data transfer via mutual electromagnetic coupling with the reading device or host. The reading device includes an antenna coupled to a reading circuit for receiving and reading the first signal representing each parking parameter stored in the parking tag memory; a validity verification means coupled to the reading circuit and a responsive to the first signal for generating a validity signal; and an output means coupled to the validity verification means and responsive to the validity signal for producing a visual or audible output.

The use of RF communication in the system provides a solution to the problems from visual checking of parking tags/meters. The parking offence event can also be recorded into the corresponding parking tag via the RF communication between the reading device and the tag, so that the problem of disagreement between the warden and the motorist on the offence/offence ticket can be significantly reduced.

The system using electronic parking tag with RF communication devices provides a solution to the problems of (1a) to (1c). However, the system has some drawbacks relating to security and RF communication which are described as follows:

5

(1) Security Problem: The portable parking tag uses a memory to store pre-purchased credit, which can be renewed by using a terminal via RF communication. This conception is quite fragile in the security aspect in that the RF communication signals for renewing credit can be easily captured and reproduced by someone.

10

(2) Drawbacks from using RF technology: To obtain a fast and efficient checking, the most suitable communication distance between the reading device and parking tags should range from 1 to 2 meters. However, due to constraint in antenna size, power consumption, cost and RF interference, the communication distance is limited to a very short range, normally less than 10 to 20 centimeters. Using high frequency radio wave can increase the communication distance with small antenna size, but this is costly.

15 OBJECT OF THE INVENTION

It is an object of the invention to at least partially overcome some of the above mentioned difficulties of existing systems for monitoring and collecting parking fees.

SUMMARY OF THE INVENTION

20 Accordingly the invention resides in a parking fee monitoring and collection system comprising in combination at least a smart-card as secure portable memory means; an in-vehicle parking meter; an enforcement means; and a top-up and settlement means;

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CHARACTERIZED IN THAT:

the smart card includes:

a secure memory for storing prepaid credit, parking parameters and parking transaction records;

5 and in that the in-vehicle parking meter includes :

a smart card interface for card reading and writing,

an infrared device consisting of an infrared receiver for receiving coded infrared waves and converting it into electronic data, an infrared transmitter for converting coded electronic data into infrared wave and transmitting it out; a
10 circuit for decoding the data received and coding the data to be transmitted,

a parking meter memory for storing car park pricing parameters and parking transaction records,

a real time clock circuit for providing the data of date and time,

a microprocessor coupled to the smart card interface, the infrared device,
15 the memory and the real time clock circuit, and being adapted to compute the parking charge based on the parking parameters related to the selected parking zone, date and time, and to the parked time, to authenticate the smart card, to control the parking transaction and record including card reading and writing, to read the first received signal from the infrared device and verify it, and in the
20 case where the signal is an inquiry signal from a enforcement means, to send a response including meter status and parking transaction records to the enforcement means, and to control the updating of the parking parameters stored in the meter;

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and in that the enforcement means includes:

an infrared device consisting of an infrared transmitter for converting coded electronic data into infrared signals and transmitting it out, an infrared receiver for receiving coded infrared waves and converting it into electronic data,
5 a circuit for coding the data to be transmitted and decoding the data received,

a memory for storing parking parameters, parking transaction records received from parking meters, and the records of issued parking offence notices by the enforcement means itself,

a real time clock circuit for providing the data of date and time,

10 a portable output means for producing parking offence notices,

a microprocessor coupled to the infrared device, the memory, the time clock circuit and the output means, and being adapted to remotely check the validity of the in-vehicle parking meter and to record and issue parking offence notices, to transfer parameters into parking meters;

15 in that the top-up and settlement means include:

a terminal including a smart card interface for card reading/writing for transferring a credit and parking parameters to a smart card at same time for collecting the parking transaction records from the smart card, a management means for parking parameters management, and a settlement means for settling
20 collected parking charges to corresponding car park owners' account.

According to a preferred feature of the invention the pre-purchased credit is stored in the smart card. The credit in the smart card can be deducted by a parking meter but never be transferred into a parking meter.

25 According to a preferred feature of the invention the infrared devices used in the parking meter and in the enforcement means provides a communication distance of up to 2 meters with small device size, small power consumption, no RF interference and low cost.

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According to a preferred feature of the invention the parking parameters include parking charge rates related to different car park zones, type of days and time periods with a version number and effective date.

5 According to a further feature of the invention the parking parameters are set by the car park owners or by the relevant authority and can be modified as and when the need arises. The parameters are stored in the top-up terminals and any variations are transferred into the smart card during top-up operation.

10 According to a further feature of the invention the in-vehicle parking meter comprises a table of current parking parameters with a version number and a table of spare parking parameters with a corresponding version number and effective date in its memory. When the effective date of the spare parking parameters is reached, the parking meter will update the current parking parameters to be the same as that of the spare parameters. When a smart card is inserted, the parking meter will read the version number of the parking parameters in the card, and if the version is later than that of the spare parking parameters in the parking meter, the parking meter will update its spare parking parameters to be the same as those of the parameters in the card.

20 According to a preferred feature of the invention the parking transaction record includes a charged amount related to a corresponding car park owner, the parking start and end time and the transaction date and time.

25 According to a further preferred feature of the invention the parking transaction is recorded in both the smart card and the parking meter memory. The records in the smart card will be collected by the top-up means and processed by the settlement means, while the records in the parking meters can be gathered by using the enforcement means and processed by the corresponding car park managers for the car park owners' reference.

According to another preferred feature of the invention the said parking meter comprises a memory for storing the parking offence notice received from the enforcement means via infrared communication means.

According to a further preferred feature of the invention the in-vehicle parking meter also comprises operation interfaces, such as buttons and display for parking zone selection, metering starting and stopping.

5 According to a preferred feature of the invention the enforcement means comprises an interface for linking to the car park management host, for uploading the collected parking transaction records and the parking offence records.

According to a further preferred feature of the invention the enforcement means has a function of calibrating the real time clock in the parking meter.

10 DESCRIPTION OF PREFERRED EMBODIMENTS

The invention will be more fully understood in the light of the following description of several specific embodiments. The description is made with reference to the accompanying drawings of which:

Figure 1 which is a schematic representation of a parking fee monitoring system
15 for open public car parks according to the first embodiment;

Figure 2 illustrates the display and the in-vehicle parking meter according to the first embodiment;

Figure 3 illustrates the enforcement device and the interconnection between the elements of the enforcement device according to the first embodiment;

20 Figure 4 illustrates the display and the interconnection between the elements of the top-up machine according to the first embodiment;

Figure 5 which is a schematic representation of a parking fee monitoring system for closed public car parks according to the second embodiment.

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The open public car park parking fee monitoring system, according to the first embodiment as illustrated schematically at in Figure 1 is intended for use in open car parks, and comprises in combination a smart card as a secure portable memory means (1) functioning both as a reloadable stored value card and as a carrier of the data related to the identity of the vehicle owner, the parking parameters and the parking transaction records related to car park owners; and an in-vehicle parking meter (2) that has a microprocessor and an infrared communication device (7) where the in-vehicle parking meter (2) is used to calculate the parking fee, to debit the fee from the smart card (1) and to communicate with an enforcement device (3) with an infrared communication device (15) which also forms part of the combination and which is to be used by car park wardens to check the validity of parking meters and to record and print parking offence notices. The embodiment further comprises a top-up machine (4) for replenishing the smart card, for collecting the necessary information regarding previous transactions for settlement purpose, and also for updating car park pricing parameters in the in-vehicle parking meter through the smart card (1).

The smart card used in the first embodiment is an IC card conforming to ISO 7816-1,2,3 and 4 standards with a microprocessor in the IC chip and which is a portable digital data carrier with high security due to its specially designed protection logic circuit, security code, and cryptographic keys, encryption and authentication algorithms.

The smart card used in the embodiment has two roles :

- (a) a reloadable stored value media for providing credit for parking fee payment where the prepaid credit is stored in the card and deducted by the parking meter according to parking rate and parked time.
 - (b) a carrier of data related to the owner of the vehicle, the owner of the parking place (bucket) and to the car park pricing parameters.
- In regard to the bucket, a car park owner's bucket is a memory

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zone assigned to a car park owner and is used to accumulate the charged parking fee of previous parking transactions that belong to the owner of the parking place. When the card is being replenished, the amount in the bucket relating to previous transactions will be transferred into a corresponding "pool" provided in the top-up-machine for settlement purpose.

The car park pricing parameters include the parking rate related to a parking zone, the date and time; time unit of charging; beginning and end points of time zones, etc. These parameters are set by the car park owner or by the relevant authority and are subject to modification as and when the need arises. The parameters are stored in the top-up machine and any variations are transferred into the smart card during top-up operation to be transferred to the in-vehicle parking meter when the card is inserted into the in-vehicle parking meter .

The smart card used in the embodiment can be a special parking card or a general purpose cash card with a special parking file.

The in-vehicle parking meter (2) of the embodiment as shown at Figure 2 comprises an off-line smart card pricing terminal which is the size of a pocket calculator and is to be placed on the dashboard or the inside window screen of the vehicle. The parking meter (2) has a first memory (8) accommodating information in regard to the parking tariffs according to the parking zones available to the motorist, the parking time, the time of day and particular days of the year, a clock (9), a power supply unit (13) and a microprocessor (11) with its software (12) which is able to calculate the parking fee payable based on the parking rate, the parked time, the time of day and the particular day of the year. In addition the in-vehicle parking meter has a smart card interface (10) which is adapted to receive the smart card to access the memory contained in the card in regard to the credit available in the card and the parking parameters. The microprocessor is able to deduct the parking fee from credit stored in the smart card provided the smart card has been installed in the interface. The credit which is deducted at each parking transaction is in turn recorded in the bucket in the smart card in order to identify the party (ie parking place owner) to whom the

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credit is to be credited when the smart card is again topped up from the top-up machine. In addition, the in-vehicle parking meter comprises a table of current parking parameters with a version number and a table of spare parking parameters with a corresponding version number and effective date in its
5 memory. When the effective date of the spare parking parameters is reached,
the parking meter will update the current parking parameters to be the same as
that of the spare parameters. When a smart card is inserted, the parking meter
will read the version number of the parking parameters in the card, and if the
version is later than that of the spare parking parameters in the parking meter,
10 the parking meter will update its spare parking parameters to be the same as
those of the parameters in the card.

On parking the vehicle at a parking place, a motorist inputs into the in-vehicle parking meter, the relevant code for parking zone by using the cursor buttons (5) and the LCD (6) which also displays other pertinent information such as date,
15 time, the balance of credit available in the smart card, parking fee, etc. As stated the memory (8) in the in-vehicle parking meter includes the parking parameters as the parking pricing table set by relevant authority. The pricing table contains parking parameters such as parking rates, zone, date and time. The parking parameters in the table can be modified by the authority when it is
20 necessary. The new parking parameters are stored in the top-up machines and transferred into the in-vehicle parking meter through the smart cards. The clock (9) is used to provide real time clock and calendar functions and is linked to the microprocessor. The smart card interface (10) is for the reading and writing of the card. In addition the in-vehicle parking meter incorporates a communication
25 means which comprises a transmitter and receiver in the form of an infrared communication device (7) which is able to receive the query signal and the time calibration information from the enforcement device (3) as shown in Figure 1, and transmit the meter status (such as current date and time of the parking meter clock, zone number, starting time and parked time, current charging rate,
30 and etc.) to the enforcement device for validity checking. The microprocessor (11) is programmed to find the actual parking rate from the pricing table according to the parking zone selected, the date, and the time of day, the day of

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the year in order to calculate the parking fee, and to perform debit transaction control, parameter transfer control, communication, security (such as authentications, encryption and etc.) and other functions.

The enforcement device (3) as shown at Figure 3 is used by car park wardens
5 for checking the in-vehicle parking meter validity, calibrating the time clock in the in-vehicle parking meter (when necessary), and dealing with parking offences. The verification of the validity of the in-vehicle parking meter includes the checking of the parameters received from the meter through infrared communication, such as security code, date, time, parking zone, pricing rate,
10 etc. Once a warden presses the checking button of the enforcement device, an infrared query signal is sent to the parking meter to be checked. The meter will respond by returning its status and working parameters. If there is a small time difference between the time clock of the meter and that of the enforcement device, the enforcement device will send a time calibration information package
15 to the meter to correct its real time clock. If any error in the meter is detected, the enforcement device prompts the warden to input the car registration number, and then it will print a problem or offence notice. The enforcement device also allows the warden to input the parking place errors, such as parking in places other than in a parking lot, failing to obey signals, and etc., and to print the
20 parking offence notices. The parking offence records stored in the enforcement device can subsequently be uploaded to a management station when the warden returns to the office. The enforcement device has an alphanumeric keypad (22) and a LCD display (14) which allows the warden to input the relevant car parking zone number, to start the in-vehicle parking meter checking,
25 to input car registration numbers, the parking place, error codes, etc. An infrared communication device (15) is used for exchanging information with the in-vehicle parking meter. A small printer (16) is used to print parking offence notices. The memory (20) includes the same car park pricing table as that in the in-vehicle parking meter. A real time clock (17) provides date and time data and a power
30 supply unit (21) for providing electrical energy. The enforcement device is provided with a microprocessor (18) and its software (19) which are used for checking the validity of the in-vehicle parking meter, for calibrating the time clock

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of the meters, and for performing other functions such as keypad control, print control, communication control, etc.

The top-up machine shown at Figure 4 is used to replenish the credit in the smart card, to update the parking parameters stored in the card, and to deal with the operations related to parking fee settlement. The top-up machine can either be a machine specially designed for the parking fee monitoring system use only or may be an Automatic Teller Machine (ATM) in which the necessary hardware and software for the parking fee monitoring system has been integrated. The top-up machine comprises a smart card interface (24) which is used for reading and writing the smart card; a monitor (or display) (27), a keyboard (28); a printer (23) for producing receipts; a power supply unit (29); and a microprocessor based processing device (26) including a software (25) for performing the functions of:

- (a) smart card top-up (loading a credit into the purse file in the smart card by an exchange of cash or a bank account transaction);
- (b) management of parking parameters (accept new parameters set by relevant authority; transfer the new parameters to smart cards).
- (c) settlement which involves the extraction of the parking fees charged for previous transactions from the portion of the memory in the smart card relevant to the bucket of the parking place owner, and the transfer of the amount to the corresponding owner's account.

In the case of the first embodiment as described above and as shown in the drawings the smart card provides the store for the credit which is to be consumed by the in-vehicle parking meter.

The second embodiment which is schematically illustrated at Figure 5 is of a very similar form to the first embodiment is intended for use in association with a closed car park where the entries and exits are controlled by gates or booms (32) which are each associated with a barrier controller (31). In the case of the
5 second embodiment each barrier controller is provided with an infrared scanner (30) which can be mounted on the gate or boom or the support therefor and which is able to communicate with the in-vehicle parking meter (2) of a vehicle as it approaches the gate or boom (32).

The scanner associated with an entry to the car park communicates with the in-
10 vehicle parking meter of an incoming vehicle to ensure that there is a valid smart card in the parking meter and if there is sufficient credit in the card to activate the in-vehicle parking meter and open the gate or boom.

The scanner associated with the exit of the car park communicates with an exiting vehicle to deactivate the in-vehicle parking meter check. At this point in
15 time the microprocessor of the in-vehicle parking meter will determine the parking fee payable and deduct that fee from the credit stored in the smart card. If at the conclusion of the transaction, the parking fee has been successfully deducted from the card, the controller (31) will open the gate or boom (32).

20 It should be appreciated that the scope of the present invention need not be limited to the particular scope of the embodiments described above.

The claims defining the invention are as follows:

1. A parking fee monitoring and collection system comprising in combination at least a smart card as secure portable memory means (1), an in-vehicle parking meter (2) with an infrared communication device (7), an enforcement means (3) with an infrared communication device (15), and a top-up and settlement means (4);

CHARACTERISED IN THAT:

10 the smart card (1) as a secure portable memory comprises a reloadable first store for storing pre-purchased credit, a second store capable as serving as a carrier of the data related to parking parameters, and a third store for carrying parking transaction records; the pre-purchased credit is stored in the smart card (1) and can be deducted by a parking meter but never be transferred into a parking meter.

15 the in-vehicle parking meter (2) includes a smart card interface (10) for card reading and writing, an infrared device (7) for effecting remote communication with the enforcement means (3), a parking meter memory (8) for storing parking parameters, a real time clock circuit (9) for calendar and date-time functions, a power supply unit (13), a microprocessor (11) coupled to the smart card interface (10), the infrared device (7), the memory (8) and the real
20 time clock circuit (9), and being adapted to compute the parking charge based on the parking parameters related to parking zone, date and time, and to the parked time, to authenticate the smart card, to control the parking transaction and record including card reading and writing, to read the first received signal from the infrared device (7) and verify it, and in the case where the signal is an
25 inquiry signal from a enforcement means (3), to send a response including meter and parking status to the enforcement means (3);

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- the enforcement means includes an infrared device (15) for effecting remote communication with the parking meter (2), a memory (20) for storing parking parameters and records of parking offense notices issued by the enforcement means itself; a real time clock circuit (17) for providing the data of date and time; a microprocessor (18) coupled to the infrared device (15), the memory (20), the time clock circuit (17), and being adapted to remotely check the validity of the in-vehicle parking meter (2) and to issue parking offence notices,
- the top-up and settlement means (4) includes a terminal comprising a smart card interface (24) for transferring a credit and parking parameters to a smart card (1) and at same time for collecting the parking transaction records from the smart card; a management means for parking parameters management, and a settlement means for settling collected parking charges to corresponding car park owners' account.
2. The system according to Claim 1 wherein the infrared device used in the parking meter (2) or in the enforcement means (3) comprises an infrared receiver for receiving coded infrared signals and converting it into electronic data, a infrared transmitter for converting coded electronic data into infrared signal and transmitting it out; a circuit for decoding the data received and coding the data to be transmitted.
3. The system according to Claim 1, wherein the parking parameters include parking charge rate related to different car park zones, type of days and time periods.
4. The system according to Claim 1 and 3, wherein the parking parameters are set by car park owners or by the relevant authority and can be modified as the need arises. The parameters are stored in the top-up terminals and any variations are transferred into the smart card during the top-up operation of the card.
5. The system according to Claim 4, wherein the parking meter memory (8) comprises a table of the current parking parameters and a table of the spare parking parameters with a version number and an effective date.

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- 5 6. The system according to Claim 5, wherein the parking meter will update the current parking parameters to be the same as that of the spare parking parameters once the spare parking parameter becomes effective. When a smart card is inserted, the parking meter will read the version number of the parking parameters in the card, and if the version is later than that of the spare parking parameters in the parking meter, the parking meter will update its spare parking parameters to be the same as those of the parameters in the card.
- 10 7. The system according to Claim 1 wherein the parking transaction record comprises a charged parking fee amount related to a corresponding car park owner, the parking start time and end time and the transaction time.
8. The system according to Claim 7 wherein the parking transaction records are also stored in the parking meter's memory and can be collected by the enforcement means via infrared communication.
- 15 9. The system according to Claim 7 to 8, wherein the enforcement means comprises an interface for linking to car park management host for uploading the collected parking transaction records and the parking offence records.
- 20 10. The system according to any one of the preceding Claims, wherein the parking meter comprises operational interfaces, such as buttons, switches and display, for manual operation of parking zone selection, starting/stopping metering.
11. The system according to Claim 1, wherein the parking meter memory (8) comprises also a store for storing parking offence notice record received from the enforcement means.
- 25 12. The system according to any of preceding Claims, wherein the enforcement means comprises a function of calibrating the real time clock of the parking meter via infrared communication.



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ABSTRACT

A PARKING FEE MONITORING AND COLLECTION SYSTEM

A parking fee monitoring and collection system comprising a smart card (1) as secure portable memory; an in-vehicle parking meter (2) with an infrared communication device (7); an enforcement means (3) with an infrared communication device (15); and a top-up and settlement means (4); the smart card (1) as secure portable memory means adapted to store a credit value and also adapted to store data related to car park owners, previous transactions and car park pricing parameters; the in-vehicle parking meter (2) having a smart card interface for card reading and writing, an infrared device (7) for communicating with the enforcement means; a microprocessor (11) being adapted to calculate a parking fee according to the car park pricing parameters and the particulars of the parking zone, the time of day, the day of the year and the parked time, to debit the parking fee from the smart card; said infrared communication means
15 being adapted to remotely communicate with the enforcement means to provide data to the enforcement means; whereby the enforcement means is able to be used to remotely check the validity of the in-vehicle parking meter and to record and print parking offence notices; the top-up machine being adapted to transfer a credit to the smart card, update the status of the car park pricing parameters in
20 the smart card and obtain transaction data necessary from the secure portable memory regarding previous transactions for settlement purpose.

Figure 1

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DRAWINGS

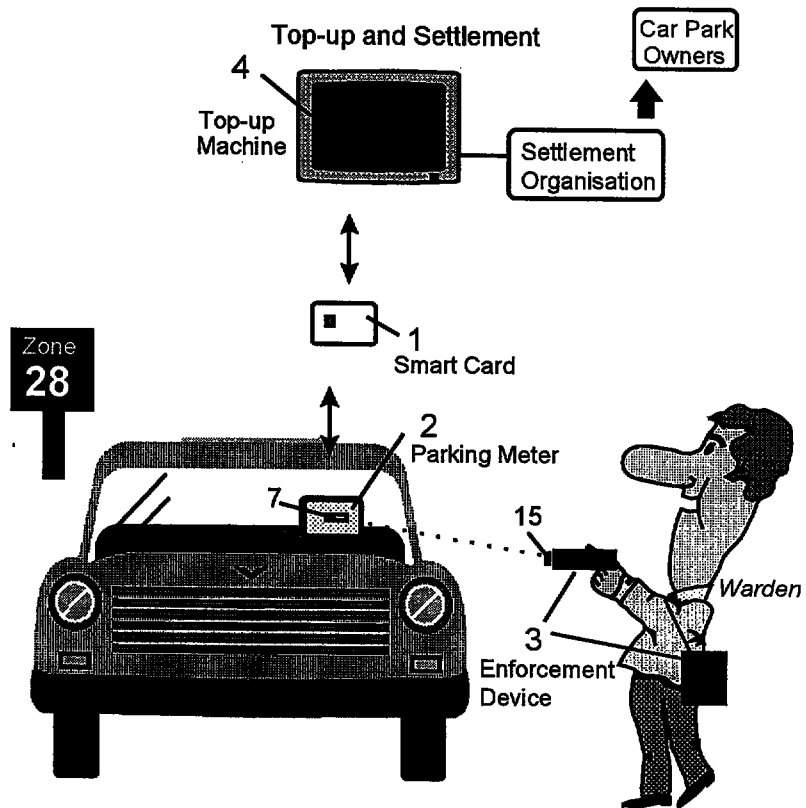


Figure 1

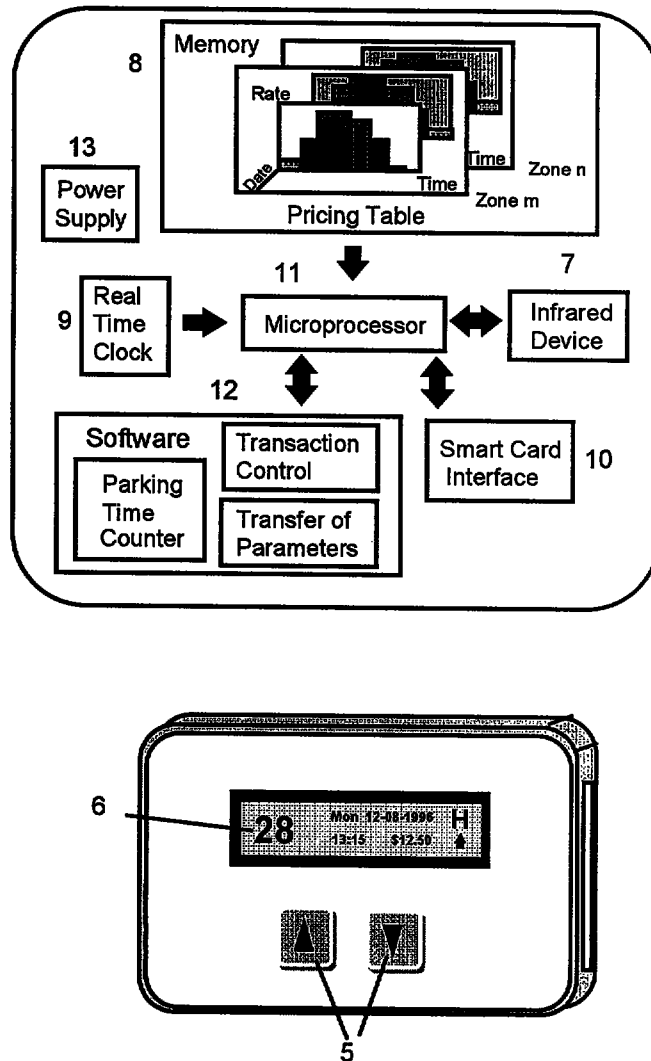


Figure 2

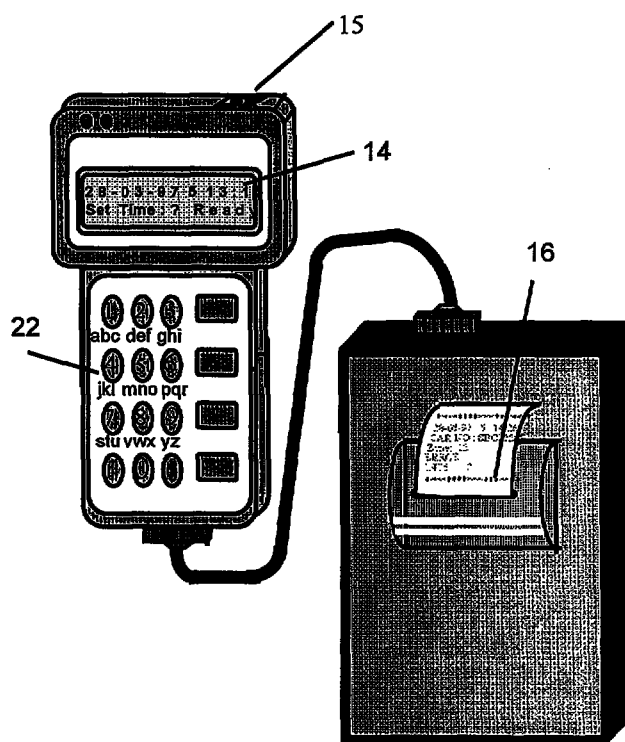
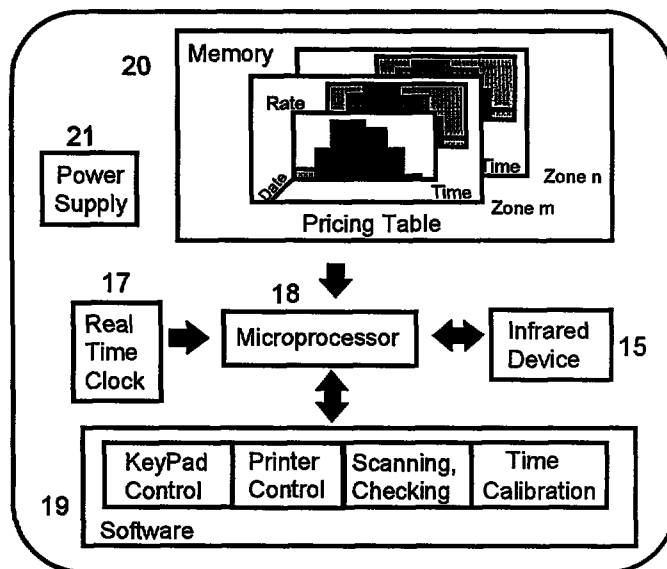


Figure 3

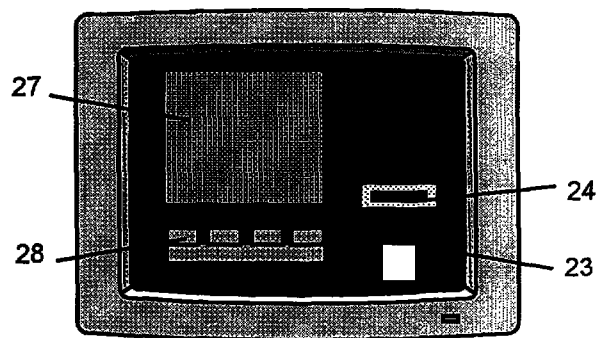
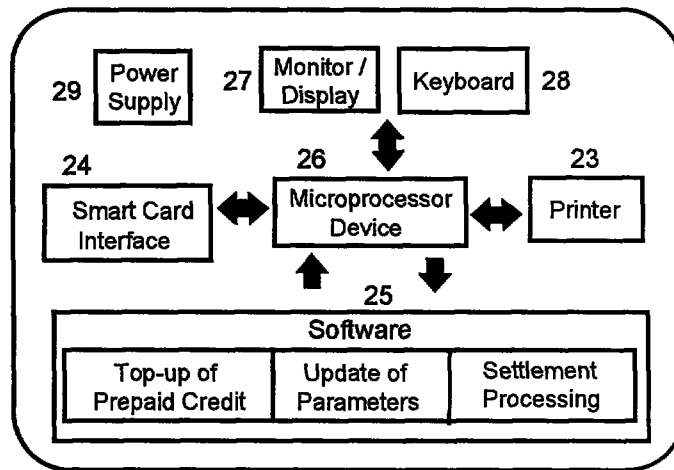


Figure 4

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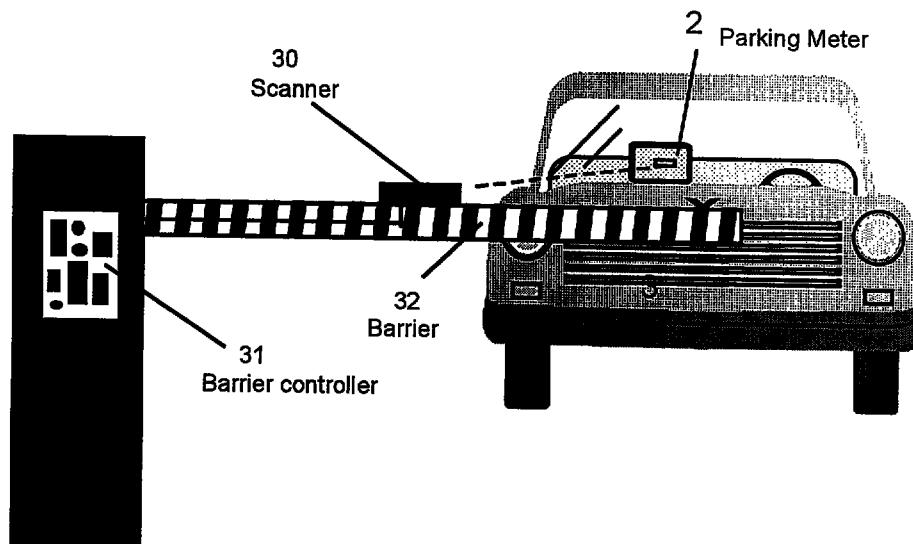


Figure 5

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