(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 548 653 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.06.2005 Bulletin 2005/26

(51) Int Cl.[7]: **G07C 5/08**

(21) Application number: **04257028.3**

(22) Date of filing: **12.11.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK YU

(30) Priority: **27.11.2003 GB 0327557**

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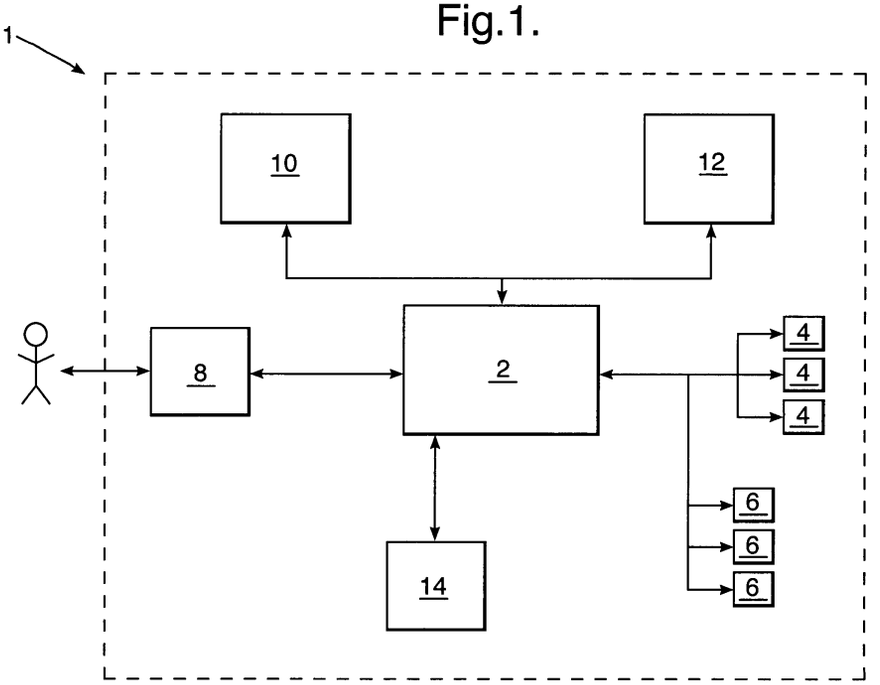
(54) Reduction of damage to a vehicle

(57) Disclosed is a method of reducing damage, or the risk of damage, to a vehicle, comprising the steps of using monitoring means to monitor one or more elements of vehicle usage associated with damage, or the risk of damage, to the vehicle or components thereof; and providing feedback to a user of the vehicle, calculated from one or more elements of vehicle usage monitored by the monitoring means and associated with damage, or the risk of damage, to the vehicle or components thereof.

Fig.1.



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Description

Field of the invention

[0001] The invention relates to reduction of damage to a vehicle and concerns a method of reducing damage (or the risk of damage) to a vehicle and apparatus for this purpose. This invention relates particularly, but not exclusively, to leased, hired or rented vehicles.

Background to the invention

[0002] The present invention relates to vehicles, being machines with an engine, that can be used for transporting people or goods. These vehicles are typically road motor vehicles (e.g. cars, vans, trucks), but they could equally be water-based vehicles such as boats, air borne vehicles such as aeroplanes, or other pieces of motorised equipment, such as forklift trucks.

[0003] The way in which a vehicle is driven can have a substantial effect on the rate at which the vehicle or components thereof, wear out. For example, a vehicle that is accelerated hard and braked hard will suffer greater wear and tear on the brake systems, resulting in more rapid wearing out. Thus, one object of the present invention is to reduce the damage (or risk of damage) to a vehicle or components thereof due to the way in which the vehicle is used.

[0004] Relatedly, the way in which a vehicle is driven can have significant implications for the safety of the driver; for example, high accelerations, particularly around road bends, high speed movement in excess of a speed limit, use of the vehicle with incorrect tyre pressures and so forth, all affect the safety of the vehicle, passengers and contents.

[0005] Accordingly, it is desirable to enable and cause a driver of a vehicle to drive the vehicle in as safe a fashion as possible.

[0006] Some embodiment of the invention aim to provide a vehicle, the value of which can be more accurately judged than is the case with conventional vehicles. At the present time, the only measures readily available to a user or potential user of a vehicle to judge the extent to which the vehicle or its components have been worn, is by reference to the age of the vehicle, and the distance which it has travelled, if an odometer is fitted to the vehicle.

[0007] A further, related problem occurs when the users of the vehicle are not the owners or those financially liable for the vehicle. In this case, the users of the vehicle may have no or little incentive to look after the vehicle. Therefore, an object of the invention is to reduce the damage to vehicles by users who are not the owners of the vehicles.

[0008] One circumstance in which this occurs is when a company owns a vehicle, or a fleet of vehicles, driven by employees. Another circumstance when an individual or organisation (lessee) requiring the use of a vehicle, leases the vehicle from a leasing company (lessor). The lessor retains ownership of the vehicle, so that the lessee does not actually purchase the vehicle. Instead, the lessee is in effect renting or hiring the vehicle over a time period (which is typically fixed, but can be variable). The lease is a legal agreement by which the lessee pays money in order to use the vehicle.

[0009] At the present time, a typical leasing agreement would be as follows:

1. The lessee pays an initial deposit (perhaps equivalent to 3-6 months usage fees) to the lessor.

2. The lessee may also pay other up front fees as required by the lessor.

3. Thereafter, the lessee pays regular (usually monthly) instalments to the lessor.

4. The size of the instalment is set at the outset based upon the price of the vehicle at the time of purchase, less the assumed residual value at the end of the plan plus a suitable return on investment for the lessor.

5. In calculating the assumed residual value at the end of the plan, the lessors will typically either base their calculations on a typical distance travelled by such a vehicle (in miles or kilometres) or ask the lessee to declare at the start what distance they expect to drive during the duration of the lease.

6. If this distance limit is exceeded during the lease, punitive charges are usually levied on the lessee at the end of the lease period.

7. A leasing plan is typically of 3 years in duration, although other plan lengths are not unusual.

8. A leasing plan is usually for a fixed period of time that is agreed up front, although it may be possible in certain circumstances for the lessee to end the lease earlier. Where an earlier termination is possible, high penalty charges

usually apply, making this an unattractive option for the lessee.

9. The regular payments to the lessor may also include other motoring costs, such as regular service and maintenance costs, road tax, and the cost of replacement tyres at the end of the period.

10. Typically, direct debit (or standing order) arrangements are used to make payments to the lessor on a monthly basis.

11. Throughout the leasing period, the lessor retains ownership of the vehicle.

12. The lessee is not obliged to purchase the vehicle at the end of the period, although sometimes this is offered as an option.

[0010] If the vehicle is driven in such a way as to wear excessively the vehicle or its components, the lessor may achieve a lower sale price than expected if they sell the vehicle on at the end of the leasing period. Thus the lessor takes on a significant risk. It is desirable for the lessor to find ways to reduce the damage to the vehicle by the user during the lease period. As the only disincentive at present to the user (or the party such as a user's employer, who is the actual lessor) is the surcharge payable at the end if the mileage has exceeded an agreed amount, the current arrangement is unsatisfactory.

[0011] A further problem for a lessor is estimating the residual value of the vehicle at the end of the leasing plan. Making estimates about what may happen in the future is always risky. As a lessor typically gives a guaranteed minimum value of the returned vehicle, the lessor takes on a substantial risk.

[0012] Currently, the lessor bases the estimated residual value on two primary elements. Firstly, there is the expected market value of the vehicle at the end of the lease period. Secondly, the predicted residual value takes into account the total distance that the vehicle is expected to be driven during the lease period.

[0013] In order to estimate the market value of the vehicle, the lessor will need to use their experience of general vehicle market trends, and perhaps refer to any publications on used vehicle prices. For example, the lessor will need to consider whether the prices of used vehicles are increasing or decreasing and estimate at what rate prices will change.

[0014] A key problem the lessor faces in producing an accurate estimate is that the world is changing at an ever-faster rate and the projections of what may happen in three years time is risky. New lessors entering the market may have little knowledge or experience on which to base their estimates, making it still more likely that they will make poor estimates.

[0015] In the UK for example, the reason for this ever increasing rate of change is that over the last few years the vehicle retail market has been affected by various changing factors at the same time. These factors include changes in legislation, opening up of the vehicle retail market to more players, increased demands from consumers, new and innovative entrants to the retail sector, increased reliance on vehicles, and increased reliability of engines.

[0016] The impact of these changes on new vehicle prices have been significant, which in turn has had a knock on effect on used vehicle prices, and hence the residual value of vehicles.

[0017] Another problem faced by a lessor is how to decide on an estimate of the distance (in miles or kilometers) which the vehicle will travel during the lease period. Total mileage may be based on the lessor's experience or an up front declaration from the customer (lessee). Alternatively, the lessor may set an arbitrary mileage limit. This approach is clearly of limited accuracy, and can cause future problems for the lessee or lessor. For example, the lessee may simply have no idea of what distance the vehicle will be driven during the duration of the lease.

[0018] For example, the lessee may wish to have the vehicle driven a greater distance than they have declared or which the lessor set at the start of the arrangement. This can be a problem when the lessor has tried to limit the distance which the lessee can travel during the period, by adding in penalty clauses. Any lessee exceeding the distance limit could find they have a large monetary penalty to pay at the end of the lease period.

[0019] From the point of view of the lessee, there are a number of significant problems with the traditional method of leasing or financing vehicle usage. These include:

1. If the lessee has a significant lifestyle change or change in their business which impacts on the usage they make of the vehicle, the lessee could find themselves tied in for a certain time period into what is now an unattractive deal with a limited distance they can travel in the vehicle.

2. Another problem is that the lessee may forget that they have a distance limit or forget to track their own usage of the vehicle and so the penalty at the end of the lease period could be unexpected. This becomes very important if the lessee does not have sufficient solvency to pay the penalty fees. The lessor also suffers here as they need

to pursue the money via the legal system/courts which may not be cost effective, in which case the lessor could lose out financially.

3. Another problem with being tied in to a fixed period agreement is that a lifestyle change or change to the lessee's business which was not expected could mean that the lessee wants or even needs to change their vehicle earlier than expected. For example, the lessee may change to a larger vehicle if the user of the vehicle has children. Under traditional arrangements, this is often not possible or is subject to hefty penalty fees.

[0020] A further problem facing lessors in attempting to predict a vehicle's residual value at the end of a lease is trying to understand how the customer will actually use the vehicle in order to predict the wear and tear on the vehicle and components thereof. Different lessees, and indeed different actual drivers, will use the vehicle in different ways.

[0021] Thus, the way in which a vehicle is actually used, rather than simply the total amount of use in terms of distance measured by an odometer, can clearly impact the vehicle's condition and hence value when it is returned to the lessor at the end of the period.

[0022] At the present time, lessors cannot accurately predict or estimate vehicle usage, and how that usage is personalised to a particular user. They can do this only by asking the customer lots of questions which could include (but are not limited) to the following:

1. The distance the vehicle is driven,
2. The occasions when the vehicle is driven,
3. The time the vehicle spends with the engine running
4. The driving style of the people who drive the vehicle (e.g. harsh braking, poor use of the clutch/gears, driving at excessive speed for the vehicle's capability, high engine revolutions per minute)
5. Where the vehicle is parked (e.g. is it garaged and thus protected from the elements, is it parked off the road away from vandals who might scratch the paintwork?)
6. How often will/is the vehicle driven in adverse weather conditions?

[0023] In addition, many of the factors listed above, and a large number of additional factors, such as the age/sex of the driver, the driver's driving experience, the attitude to risk of the driver, the type of road driven on, the time of day the vehicle is driven, etc. may in themselves provide clues as to how likely it is that the vehicle will be involved in an accident or damaged maliciously by a third party. This is important in calculating likely residual value, as, even if repaired, the fact a vehicle has been in an accident usually reduces its market value.

[0024] It would generally be impractical for a lessor to ask a lessee for all these details either up front or during the period of the lease. Manually recording these answers would increase time and cost of the arrangement and be more hassle for the lessee, so making the deal unattractive to them.

[0025] Even if a lessor was able to conveniently ask all this information of a lessee, the lessee may not answer truthfully. This could be a deliberate act in order to obtain as cheap a lease as possible, or simply because the lessee cannot easily predict the exact vehicle usage. Even if a vehicle user were asked about the historic vehicle usage and future predictions on this, accurate answers would not necessarily follow. For example, few people could accurately say how much time they spent in their vehicle when it was stationary, but with the engine running. It would also be difficult to ask a customer to estimate the driving styles of the people using the vehicle.

[0026] Even if all these questions were asked by the lessor at the beginning of the lease arrangement, it would still be of limited value to the lessor as the way in which the user of the vehicle uses the vehicle may change throughout the vehicle-leasing period. One reason that difficulties in accurately estimating a residual value of a vehicle at the end of a lease can cause financial problems for the lessor is because, if the residual value is actually lower at the end of the lease period than is estimated, then the lessor is left with a vehicle that is worth less than expected and the lessee has in effect, therefore, underpaid for the lease.

[0027] This means that the lessor is always running a risk relating to the future market value of the vehicle, yet that value is influenced by how the lessee uses the vehicle which is primarily outside the lessor's control.

[0028] Accordingly, an aim of the present invention is to reduce financial risks for the lessor by enabling a more accurate estimate of the residual value of the vehicle to be determined.

[0029] The above discussion relates to lease agreements, but similar considerations also apply to short-term or long-term vehicle rental or hire agreements, or personal contract purchases or hire purchase agreements in which the purchaser pays an initial deposit followed by monthly instalments of capital plus interest, for an agreed time period. In the personal contract purchase, a percentage of the capital cost is deferred until the end of the agreement. This percentage is known generally as the "minimum guaranteed future value", and is based on an estimate of the vehicle's residual value at the end of the agreement. Again, the finance company has to consider future market conditions and the vehicle's anticipated mileage, etc, as outlined above in the leasing example. At the end of the contract, the customer

can usually hand back the vehicle, part-exchange the current vehicle against a newer one, or pay the minimum guaranteed future value and keep the vehicle. If the value of the vehicle is lower than the minimum guaranteed future value and the customer returns the vehicle, then the finance company/vehicle lessor has lost out. If the value is higher, then the customer is refunded the difference. The risk of a fall into negative equity is therefore again borne by the finance company/vehicle lessor. The invention can be applied to reduce this risk for the finance company.

[0030] Accordingly, the present invention aims to minimise the damage, including wear and tear on components, made by the user of a vehicle, particularly on leased, hired or rented vehicles.

Summary of the invention

[0031] According to a first aspect of the present invention there is provided a method of reducing damage (or the risk of damage) to a vehicle, comprising the steps of:

using monitoring means to monitor one or more elements of vehicle usage associated with damage (or the risk of damage) to the vehicle or components thereof; and

providing feedback to a user of the vehicle, calculated from one or more elements of vehicle usage monitored by the monitoring means and associated with damage (or the risk of damage) to the vehicle or components thereof.

[0032] By providing feedback to a user of the vehicle related to damage (or the risk of damage) to the vehicle, the user is provided with the information enabling him or her to minimise damage (or the risk of damage) to the vehicle or components thereof. The user will often respond by altering their usage to reduce the extent to which their usage damages (or risks damage to) the vehicle or components thereof. This reduces damage (or the risk of damage) to the vehicle (so improving the residual value of the vehicle), and can have the effect of reducing the chance of crashes or other risks to the health of a user or passengers of the vehicle.

[0033] Preferably, elements of vehicle usage monitored by the monitoring means comprise those which are associated with gradual damage to the vehicle, i.e. wear.

Feedback

[0034] Feedback may comprise information concerning monitored elements of vehicle usage, or data derived from calculations taking into account monitored elements of vehicle usage. Feedback may also comprise data derived from calculations which also take into account external factors that are associated with damage (or the risk of damage) to the vehicle or components thereof, either by themselves or in conjunction with monitored elements of vehicle usage.

[0035] Preferably, feedback to the user (related to one or more elements of vehicle usage monitored by the monitoring means and associated with damage (or the risk of damage) to the vehicle or components thereof) comprises financial information relating to the value of the vehicle, or a charge, surcharge or credit in respect of use made of the vehicle.

[0036] The feedback may be continuous or periodic allowing a user to determine the effects of their usage, and enabling them further to alter their usage in light of the feedback, so further reducing damage to the vehicle or components thereof.

[0037] Feedback may be provided to the user in the vehicle through user interface means (which may be one way, or two-way interface means), or independently, for example through a statement sent to or in respect of the user through the post, or by electronic messaging means, such as e-mail, or accessible through a communication means, such as through an internet web site.

[0038] Feedback may be determined by calculations comparing one or more measured data with predetermined benchmarks, which are related to damage (or the risk of damage) to a vehicle, including wear.

[0039] Feedback may comprise explanatory text (and/or drawings) or advisory text (and/or drawings) explaining how vehicle usage has affected the value of the vehicle, or a charge, surcharge, or credit in respect of use made of the vehicle, or advising how vehicle usage could be changed to modify the effect of vehicle usage on the same factors.

[0040] Feedback may be automatically provided to the user. However, feedback may be at least partially provided on demand or otherwise in response to a request by or in respect of the user.

Monitoring means

[0041] Monitoring means preferably comprise one or more sensors or electronic devices configured to measure information (or data) about the vehicle, its environment, or usage of the vehicle. Monitoring means may be part of or fitted to the vehicle, but can be partially or entirely external to the vehicle. For example, a vehicle's location may be tracked by a system external to the vehicle, the presence of a vehicle in a congestion charging zone or toll road may

be detected by cameras which recognise its number plate or other markings.

[0042] Preferably, two or more elements of vehicle usage associated with damage (or risk of damage) to the vehicle or components thereof are monitored by monitoring means. Information provided by the monitoring means is typically monitored over a period of time, analysed and, optionally, recorded.

[0043] The monitoring means may simply monitor the total distance travelled by the vehicle. The monitoring means may monitor at least one element of vehicle usage other than the distance travelled by the vehicle. The monitoring means may monitor a plurality of elements of vehicle usage other than the distance travelled by the vehicle.

[0044] Preferably, monitoring means comprise means (preferably sensors) for determining at least the location of the vehicle and the time when the location of the vehicle is determined, either continuously or at closely spaced time intervals (e.g. every 2 seconds). From this can be calculated the speed and acceleration of the vehicle. Monitoring means may directly measure speed and/or acceleration

[0045] Monitoring means may also comprise means for measuring one or more of the following: the distance travelled by the vehicle (for example, monitoring means may comprise an odometer); the time the vehicle spends with the engine running; the time the vehicle spends moving; the time the vehicle spends stationary with the engine on (idling); the time the vehicle spends stationary with the engine off; the amount of time or incidence of harsh braking and/or acceleration, preferably as a portion of driving time (for example, the monitoring means may comprise means for measuring the strength of braking); engine speed, for example as revolutions per minute; the sideways acceleration/g-forces experienced when the vehicle is cornering; the frequency and pattern of gear changes; the proportion of time spent in particular gears; the number of times and frequency of skidding by the vehicle (in which case the monitoring means may comprise means for determining when an anti-lock braking system is activated); the speed at which the vehicle is driven, both absolutely and in comparison to the speed limit in force at the location where the vehicle is determined to be; the location where the vehicle is parked and/or kept, particularly at night; the frequency and amount of driving of the vehicle in adverse weather conditions; the style of driving of a user in specific weather conditions, including temperature conditions; deployment of airbag; the number of occupants of the vehicle; the number of occupied seats in the vehicle; the total weight of the occupants and/or their luggage and/or the overall weight of the vehicle; tyre pressures; type of road which the vehicle travelled down and/or other characteristics of the road, such as characteristics of the road surface; the time of day of use; whether a tow bar is being used; the weight of a load being towed; which user of several specified users is driving the vehicle (for example, monitoring means may comprise means for identifying a user).

External monitoring means

[0046] Feedback provided to a user may also be calculated from data measured by sensors external to the vehicle, for example an external vehicle tracking system, a vehicle registration plate detection system, cameras or movement sensors for determining traffic speed and volume in a particular locations.

Input data

[0047] Feedback may also be calculated from data input to a computing system; for example, whether the vehicle suffered from any accident damage; the number of children and/or animals which regularly travel in the vehicle; the use of the vehicle (whether it is generally for leisure, commuting or business purposes); the service schedule and history of the vehicle; weather conditions at the location where the vehicle is at a given time; traffic volume at the location where the vehicle is at a given time; the identity of the user of the vehicle etc. Such input data may be input by or in response to information supplied by or on behalf of a user of the vehicle, or may be received from an information source external to the vehicle, such as a weather information service or traffic information service.

Computing means

[0048] The provision of feedback typically requires one or more computation steps to be carried out by computing means. Computing means may be located within the vehicle, and preferably comprise an in-vehicle computing means. The in-vehicle computing means may comprise a microprocessor, storage means and a power supply. The power supply may be stand alone (e.g. a battery) or may comprise a connection to a vehicle's power supply. Nevertheless, computing means may equally be located externally to the vehicle. In a preferred embodiment, computing means comprise central computing means for receiving data from a plurality of vehicles and optionally storing that data, sending feedback to the vehicle or a user thereof, and/or carrying out computational steps on the received data. The received data may comprise elements of vehicle usage monitored by the monitoring means, or data derived from the measurements made by monitoring means. Preferably, the central computing means and in-vehicle computing means are each operably connected to communications apparatus for two-way communication therebetween. The central computing

means typically comprises one or more computers and data storage.

[0049] Some elements of vehicle usage may be monitored directly and taken into account in calculations to determine feedback. For example, the speed of the vehicle may be monitored by an electronic device receiving information from a vehicle's speedometer. Information concerning the total distance travelled may be received from a vehicle's odometer. Information concerning acceleration may be received from an accelerometer. Information concerning the position of a vehicle may be received from position monitoring means, such as a receiver for a satellite based positioning system, such as the Navstar Global Positioning System (often referred to as the Global Positioning System (GPS)) or Galileo. Means for determining position may be a stand alone device present in the vehicle, or may comprise a remote means for monitoring the location of the vehicle, for example means for monitoring a radio signal emitted by the vehicle.

[0050] Alternatively, or as well, the feedback may be determined taking into account data derived by calculation from data measured by monitoring means. For example, the computing means may calculate the velocity of the vehicle from the rate of change of position of the vehicle, based on information on vehicle position and time, the acceleration of a vehicle from changes in the measured or calculated velocity, or changes in position of the vehicle with time.

[0051] Thus, the provision of feedback typically includes the step of carrying out a computational process taking into account data measured by monitoring means, and preferably also other data. This computational process may take place on the in-vehicle computing means, the central computing system or a mixture thereof. The computational process may take into account data already stored, or measured where required. Measured data, or data calculated taking into account measured data may be periodically transmitted from in-vehicle computing means to the central computing system.

[0052] Preferably, computing means carry out calculations to determine data relating to the vehicle's usage and/or the driving behaviour of one or more users of the vehicle.

[0053] The computing means may comprise one or more interfaces or connections for receiving information from an engine CANbus, an engine management system, or the parts of a vehicle such as the ignition. Indeed, the electronic devices may be part of an in-vehicle engine management computer system.

[0054] The electronic devices may further comprise wiring, antennae for receiving radio signals (which may comprise data), or one or more telematic devices. Electronic devices may comprise one or more batteries or other power sources, or one or more back up power sources. The electronic devices may comprise one or more memory chips or other data storage means, one or more sensors, gyroscopes, accelerometers or other measuring devices.

[0055] Preferably, the electronic devices comprise a communication system, which is preferably wireless, and preferably two-way. For example, a GPRS, GSM, WiFi, or Bluetooth communications system. Other communications systems could include satellite, radiofrequency or other communications technologies. The two-way communication system may be used to transmit data from the vehicle to the central computing system, or for the in-vehicle computing means to receive data from a central computing system, or software upgrades for the electronic devices.

[0056] The communication system may also be used for voice calls to and from the user of the vehicle or passengers of the vehicle.

[0057] Nevertheless, data may be transferred from the in-vehicle computing means to the central computing system, or vice versa, or both, using portable data storage means, such as a smart card which interfaces alternatively with the in-vehicle computing means and the central computing system (perhaps by interfacing with a personal computer or mobile computing device communicatively linked to the central computing system).

[0058] The electronic device may comprise one or more interface means for interfacing with, or means for communicating with user interface means already provided in the vehicle. The user interface means may be combined with identification technology such as a reader for biometric information, such as a retina scanner, or maybe it may comprise a key pad for receiving identification number, a reader for a smart card, or a radio or infrared signal from a key. Thus, the electronic device may operate only when an identified user is present, or may identify a particular user, and carry out calculations, or store data relating to a particular user of the vehicle.

[0059] The electronic devices may be entirely stand alone, or may communicate with an external computer system.

[0060] Data measured or calculated by monitoring means may be transmitted to central computing means. This may occur periodically at pre-determined or variable time intervals. Data may be transmitted when the vehicle passes through a location where communication is possible, for example, a region where it is possible to communicate through a mobile telephone link, or a WiFi or Bluetooth active region.

The data measured by monitoring means or calculated from measured data may be measured and/or transmitted at time intervals that may differ for each data item. For example, the location of the vehicle may be determined/transmitted every 10 seconds, but the speed of the vehicle may be transmitted every 2 seconds, or only when it exceeds a certain threshold (e.g. the prevailing speed limit, such as 70 mph). One or more data items may be transmitted only when their value is within or outside a specified range or above or below a threshold. The ranges or thresholds appropriate may themselves be variable depending on measured or calculated parameter under consideration.

[0061] Data measured by monitoring means in the vehicle may be used along with data collected from other sources to determine one or more elements of vehicle usage associated with damage (or the risk of damage). For example,

information concerning the speed and acceleration with which the vehicle is driven may be analysed in the light of weather data received from a weather information service provider pertaining to the location where the vehicle is at the time, to determine whether the vehicle is being used appropriately to the local weather conditions. For example, if the vehicle was being used for high levels of acceleration and deceleration in a location where it was, or recently had been raining or snowing, this would be associated with a high level of risk of damage to the vehicle.

[0062] Calculations may also be carried out taking into account information received from the user of a vehicle. For example, location of their office and their home may be used along with data concerning the position of the vehicle with time, thus allowing the calculation of what fraction of the vehicle's mileage is regular commuting trips.

Financing

[0063] The invention finds particular application in situations where the user of the vehicle is not the owner of the vehicle. In this case, feedback on vehicle usage will generally also be provided to the owner of the vehicle (or other party) as well as to the user of the vehicle. For example, the vehicle may be part of a company fleet and the user may be an employee or consultant of the company. In this case, the owner of the vehicle may benefit financially from the invention as the provision of feedback not only gives a user of the vehicle the ability to learn and modify their behaviour in such a fashion as to reduce damage (or the risk of damage) to the vehicle, but also an incentive to do so as they will be aware the owner has information on the damage (or the risk of damage) they do to the vehicle owned by the owner.

[0064] Preferably, the vehicle is leased, rented, or hired to a customer. The customer may be the user of the vehicle or one of the users of the vehicle. For example, the vehicle may be owned by a lessor, and the customer may be a lessee. The customer may be an employer of the user or users of the vehicle. Where the user is not the customer, feedback to the user may be provided via the customer as well as, or instead of, provision of feedback directly to the user.

[0065] The feedback to the customer may comprise a charge or surcharge to or in respect of the usage by the user, related to one or more elements of the vehicle usage monitored by the vehicle monitoring means and associated with damage (or the risk of damage).

[0066] Thus, unlike leasing arrangements known at the present time, the user of the vehicle is motivated to minimise usage which can lead to damage (or the risk of damage) to the vehicle.

[0067] Typically, the feedback will comprise a cost, or information concerning the applicability or otherwise of costs or surcharges.

[0068] The customer may be charged an amount of money for usage of the vehicle which includes at least a component which is calculated from the one or more elements of vehicle usage monitored by the monitoring means.

[0069] In a preferred embodiment, the owner of the vehicle has a lease arrangement with the customer. Periodically during the lease agreement, or at the end of the lease agreement, the customer may be charged a sum (constituting feedback) depending on the one or more elements of vehicle usage monitored by the monitoring means.

[0070] The following discussion specifies leases, but the invention envisages applying the same principles to vehicle rental or hire.

[0071] The method may include the step of determining a base cost for a lease for a time period (retrospectively, prospectively, or a combination of both), using at least some data collected from or in relation to, one or more prospective user of the vehicle. For example, the collected data may comprise the distance they expect to travel, their age, their address, their driving experience, the type and age of the vehicle, the service history of the vehicle, the total number of drivers.

[0072] The central computing means may be operably connected to billing computation means which control the calculation of a bill for a customer. Some of the calculations carried out in the production of feedback may therefore be carried out by the bill computation means.

[0073] Bill computation means (which may be part of, or separate from but in communication with the central computing means) may determine the base cost for a lease from the abovementioned data using an algorithm, or an algorithm selected from a group of algorithms.

[0074] A lease may have a base cost dependant on predicted or typical usage, in relation to the whole lease period, or a time period within the lease (such as a month), with surcharges (or perhaps also credits) being levied dependent on actual use. When determining the base cost of the lease, the bill computation means will typically take into account the value of the vehicle at the beginning of the lease. The bill computation means will typically also calculate a predicted future value of the vehicle, taking into account the abovementioned data, current and predicted future second-hand vehicle prices.

[0075] The feedback may comprise financial charges or credits; bonuses or penalties in the duration of the lease or other rewards or penalties dependent on usage of the vehicle, or the difference between the usage of the vehicle during the period (or part thereof) and that predicted.

[0076] The cost of the lease may be partially fixed and partially variable, including a component dependent on the

usage of the vehicle made by the user and monitored by the monitoring means, or it may depend entirely on the usage of the vehicle made by the user and monitored by the monitoring means.

[0077] The provision of feedback preferably includes the step of periodically calculating a cost for a time period (or amount of distance travelled by a vehicle), taking into account data provided by measuring means. This may include adding to the cost any additional charges or discounts for other services combined in a financial package provided to a customer. Data relating to these charges, discounts or other services may be input by a human operative or a machine through a separate administration system operatively connected to the bill computation means.

[0078] Preferably, the bill computation means checks the calculated cost for a time period against a base cost for a time period and, if a predetermined benchmark is reached, either: increases or decreases the amount of money payable by the customer in relation to that usage. A customer's payment terms may be increased or decreased in accordance with a predetermined algorithm, or the difference between the base cost and the calculated cost for a time period may be highlighted to the customer as feedback, to enable them to decide on appropriate action.

[0079] Bill computation means may be operatively connected to output means for providing feedback, such as a printer, for printing a statement to be posted to a customer, or a database or server (such as an internet server) for communicating the calculated cost, and optionally other data which has affected the calculated cost (such as data produced by monitoring means).

Preferably, the statement comprises one or more of: the cost of the lease (or other finance agreement) for a time period; summarised and/or detailed data concerning monitored usage of the vehicle for the time period; and the current or estimated future market value of the vehicle.

[0080] Preferably, the data is presented through a user interface which can be accessed, and preferably also manipulated, by a customer (and vehicle user if different). Preferably, the user interface is a graphic user interface. Typically, the interface is a web-based system which can be accessed by a customer or user through a browser. However, the user interface may be provided in the form of an email or a computer readable medium such as a floppy disc, a CD or a DVD.

[0081] The output means may also output information concerning previous payments and/or projected future payments based on past vehicle usage. User interface means may allow a customer or user to input data relating to a scenario of possible vehicle usage, and then output simulated future cost information relating to the scenario. This could enable a user to more fully understand the effects that a change in their usage (typically including their driving behaviour, and typically also in the relation to the next billing period) would have in relation to the damage (or risk of damage) to the vehicle or the cost of the lease. Similarly, the user interface means may allow a customer or user to indicate a type of vehicle, and receive data concerning the costs which would be involved in leasing that type of vehicle, taking into account the usage history of that customer or user. The user interface means may comprise means for a customer or user to instruct that their lease be changed to a lease of the type of vehicle selected.

[0082] Output means may also output the estimated value of the vehicle at a given time, where the estimated value takes into account the monitoring carried out by monitoring means.

[0083] User interface means may allow calculations to be carried out on usage data by a user. For example, user interface means may calculate and output distance travelled by the user for journeys at specific times of day or to/from specific locations, to enable them identify the amount of distance travelled for business purposes, and the amount of distance travelled for social purposes. This information can be used for tax purposes and is of value to company vehicle or fleet owners and users.

[0084] Where monitoring means comprise means to identify a driver of the vehicle, the output information can be broken down into cost and other information pertaining to individual drivers or group of drivers of the vehicle. This could allow fair sharing of costs in a vehicle sharing, or vehicle pooling arrangement. This could be useful where, for example, a parent wants to monitor their offspring's use of the vehicle and ask them for a fair contribution towards the cost of vehicle finance and/or other motoring costs, or simply where they wish to establish whether their offspring are driving in a manner which damages (or risks damage to) the vehicle. As discussed above, driving in a manner which damages (or risks damage to) the vehicle is usually linked with risk to the driver, or passengers, and so parents can use data output by output means to determine how safely their children are driving.

[0085] The invention could thus allow a user to drive a higher distance than originally anticipated early on in a lease/rental/finance period if they wish. The invention enables the leasing, finance or rental company to collect sufficient money via the bill calculation means and an associated payment collection means to cover any unanticipated depreciation in the vehicle due to the increased distance travelled, or other unexpected measured aspects of the usage of the vehicle. Thus, the invention enables the lease, rental, hire or other finance package to be priced more appropriately depending on how the vehicle is actually used and actually depreciates in value, rather than relying only on assumptions made at the outset, and is consequently more flexible than current arrangements. Alternatively or as well, any credit balance built up by the user could be used by the user to purchase additional vehicle-related/motoring services offered by the leasing or finance company.

[0086] The method may further include the step of periodically receiving information concerning the resale value of

a vehicle and taking into account changes in the predicted value of the vehicle while calculating the costs for the customer. This reduces risk for the owner of the vehicle. Information concerning the resale value of a vehicle may be obtained from sources such as databases.

[0087] By calculating the value of the vehicle in response to usage, the lease (or hire or rental agreement) may allow a customer to return a vehicle to the owner of the vehicle at any time (or certain pre-determined time points), with no or low penalty charges. They may then simply take out a new lease (or hire or rental agreement) or amend their current lease (or hire or rental agreement) to cover usage of another vehicle. This makes it easier for a customer or user to change their vehicle in the event of a lifestyle change (e.g. birth of a child, change of job necessitating a different vehicle or different method of travelling to work). Allowing customers or users this level of flexibility would not have been financially viable with known leasing arrangement.

[0088] Charges may be levied in advance of a period of usage, or retrospectively, or a combination of both. Charges may, for example, be levied monthly, or according to any regular or irregular timescale. An initial payment may be levied, followed by additional credits or debits being made as and when they are required, depending on how the vehicle is used. To increase the regularity of charges, a regular charge may be made to the user, with a cumulative credit or debit accumulated with time. Once the credit or debit reached a threshold, the regular payment amount can be adjusted appropriately to give the correct payment over the long term.

[0089] A warranty or breakdown cover could be included in the cost of a lease, hire or rental agreement, with the cost of the warranty or breakdown cover component depending partially or entirely on actual vehicle use monitored by monitoring means.

[0090] The feedback may comprise the cost or duration of warranty or breakdown cover, either as part of lease, hire or rental agreement, or without a lease, hire or rental agreement. For example, the duration of a warranty or breakdown cover may be extended if monitoring means determine that the vehicle has been used in a way which reduces damage (or the risk of damage) to the vehicle or components thereof. Thus, the warranty may apply to a specific component of a vehicle (e.g. its brakes) with the duration or cost of the warranty being calculated from monitored usage related to damage (or the risk of damage) to the brakes. The warranty may apply to one or more specific components of the vehicle, rather than a full vehicle warranty. This is beneficial in relation to components which are most affected by the total distance travelled by the vehicle, or the way in which the vehicle is driven, e.g. the tyres, brakes and exhaust.

[0091] Similarly, the feedback may include the cost and/or duration of a servicing and maintenance agreement, either in combination with or separate to a lease, hire or rental agreement. This is beneficial because certain types of vehicle usage will increase or decrease the risk of replacement parts or repairs being necessary. Monitored factors affecting the cost or duration of a servicing or maintenance agreement might therefore include one or more of measured tyre pressures, vehicle speed, frequency or amount of high acceleration or braking, use of gears/brakes etc. and might vary by vehicle make and model.

[0092] Similarly, the feedback may include the cost of products or cost or duration of services related to the vehicle, for example the cost or duration of vehicle-related legal expenses or medical/rehabilitation benefits.

[0093] The owner of the vehicle may have a long-term rental or contract hire arrangement with the customer.

[0094] The feedback may include the cost or duration of hire of the vehicle. Rather than (or in addition to) the setting of a limit in the amount of distance which can be travelled, or a geographical limit, the hirer or lessee may be charged dependent on how they actually use the vehicle during a hire period. The method may include real-time monitoring of factors monitored by monitoring means. Thus the method may extend to alerting the hirer if they are running up a higher hire bill than was originally anticipated. The hirer might be alerted by use of a terminal for a one-way or two-way communication system (e.g. a mobile telephone) fitted to the vehicle, or by transmitting a message to the vehicle responsive to which user interface means displays message, e.g. on a car dashboard. Alternatively, the feedback may comprise a text message sent to a mobile phone owned by the hirer, or an email.

[0095] The same communication methods can also be used to advise a user of a leased vehicle or vehicle whose use is governed by another type of financial arrangement when the costs associated with their usage have reached a predetermined threshold.

[0096] The same communication methods can also be used to advise a user or customer of their current bill and allow them to pay their bill from the vehicle and/or amend their monthly payment amount as relevant. This would require either a terminal for a two-way communication channel to be included in the vehicle, or for the user to have a mobile telephone or other mobile computing device or a suitable human-machine interface to allow the user or customer to authorise a payment, preferably including suitable user authentication steps.

[0097] The cost charged in relation to leasing, hire or rental may include a charge made in relation to one or more of the following additional services related to motoring: payment of vehicle tax, insurance, road tolls and/or congestion charges, vehicle service and maintenance, replacement tyres, breakdown assistance, legal expenses, medical and rehabilitation post-accident.

[0098] The feedback (e.g. charges) may apply in relation to one or more elements of the usage of multiple vehicles, monitored by monitoring means and associated with damage (or the risk of damage) to the vehicles or components

thereof.

[0099] According to a second aspect of the present invention there is provided apparatus for reducing damage (or the risk of damage) to a vehicle, comprising:

monitoring means for monitoring one or more elements of vehicle usage associated with damage (or the risk of damage) to the vehicle or components thereof;
computing means for determining feedback to be provided to a user of the vehicle from data provided by monitoring means; and
communication means for communicating feedback to the user of the vehicle.

[0100] Preferred features correspond to those of the first aspect.

[0101] In particular, monitoring means may comprise one or more sensors configured to measure information (or data) about the vehicle, its environment or usage. Monitoring means may be part of or fitted to the vehicle, but can be partially or entirely external to the vehicle.

[0102] Preferably, the monitoring means include means to determine at least the location of the vehicle and time, either continuously or at closely spaced time intervals, (e.g. every 2 seconds). From this can be calculated the speed and acceleration of the vehicle. In particular, the monitoring means may comprise a receiver for a satellite-based positioning system.

[0103] Computing means may comprise either of both of an in-vehicle computing device or a central computing system configured to carry out calculations in respect of the usage of one or more vehicles. The in-vehicle computing device and central computing system preferably each include means to communicate with each other using a wireless communication system, such as a mobile telephone network.

[0104] Feedback preferably comprises financial information relating to the value of the vehicle, or a charge, surcharge or credit in respect of the use made of the vehicle.

[0105] Communication means may comprise means for sending a written statement by post to or in respect of a user, means for transmitting an email or mobile telephone text message to or in respect of a user, or one or more servers implementing an internet graphical user interface for communicating feedback to or in respect of the user.

[0106] Preferably, the user of the vehicle is not the owner of the vehicle. Preferably, the user of the vehicle uses the vehicle under a lease, hire or rental agreement, and the feedback comprises the costs associated with or duration of the lease, hire or rental agreement

[0107] According to a third aspect of the present invention, there is provided a computing device for use in a vehicle comprising: at least one input for receiving, from monitoring means, data concerning one or more elements of vehicle usage associated with damage, or the risk of damage, to the vehicle, or components thereof; computing means operable to determine feedback to be provided to a user of the vehicle calculated dependent on the received data; and at least one output for providing the feedback to a user in the vehicle.

[0108] According to a fourth aspect of the present invention, there is provided a computing device for use in a vehicle comprising at least one input for receiving, from monitoring means, data concerning one or more element of vehicle usage associated with damage, or the risk of damage, to the vehicle, or components thereof; two-way communication means configured to transmit the received data, or data derived therefrom, to computing means remote from the vehicle and to receive therefrom remotely-calculated data; the remotely-calculated data being calculated taking into account the transmitted data; and output means for providing feedback to a user in the vehicle, the feedback being determined taking into account the received remotely-calculated data.

[0109] Preferred features of the third and fourth aspects are as described above in relation to the first and second aspects.

[0110] The invention also extends to a vehicle, provided for sale, hire, rental or lease and having associated therewith data available to a potential purchaser indicative of past usage of the vehicle, derived from measurements made during previous usage of the vehicle by monitoring means for monitoring one or more elements of vehicle usage associated with wear, or the risk of wear, to the vehicle or components thereof, including at least one element of vehicle usage other than the total distance travelled by the vehicle.

[0111] The invention also extends to a data file, preferably recorded on an electronically readable storage medium, comprising data concerning the past usage of a vehicle by a user, including data monitored by monitoring means, or calculated from data monitored by monitoring means.

[0112] Although the embodiments of the invention described with reference to the drawings comprise computer apparatus and processes performed in computer apparatus, the invention also extends to computer programs, particularly computer programs on or in a carrier, adapted for putting the invention into practice. Such computer programs may control the functioning of the central computing system, or one or more on-vehicle computers, or both operating together as a computer system. The programs may be in the form of source code, object code, a code intermediate source, an object code such as a partially compiled form, or in any other form suitable for use in the implementation

of the processes according to the invention. The carrier may be any entity or device capable of carrying the program.

[0113] For example, a carrier may comprise a storage medium, such as a ROM, for example a CD-ROM or a semiconductor ROM, or a magnetic recording medium, for example a floppy disk or hard disk. Further, the carrier may be a transmittable carrier, such as an electrical or optical signal which may be conveyed via an electrical or optical cable, or by radio or other means.

[0114] When a program is embedded in a signal which may be conveyed directly by cable or other device or means, the carrier may be constituted by such cable or other device or means. Alternatively, the carrier may be an integrated circuit in which the program is embedded, the integrated circuit being adapted for performing, or for use in the performance of the relevant processes.

[0115] Thus, the invention extends to computer software comprising program code means which, when executed on a computer, cause it to function as the computing device of the third or fourth aspect.

[0116] The invention also extends to computer software comprising program code means which, when executed on one or more computers, cause them to function as a central computing means, operable to receive data from a plurality of vehicles, the data comprising or being derived from measurements made by monitoring means of one or more elements of vehicle usage associated with damage, or the risk of damage, to each vehicle or components thereof; and to calculate therefrom feedback for provision to the users of each vehicle.

Brief description of the drawings

[0117]

Figure 1 is a schematic diagram of an in-vehicle device for use with the present invention; and

Figure 2 is a schematic diagram of a system for implementing the present invention.

Detailed description of an example embodiment

[0118] Figure 1 is a schematic diagram of an in-vehicle device 1 for use with the present invention. The in-vehicle device comprises a central control unit 2, functioning as in-vehicle computing means, comprising a central processing unit, memory, and a data storage and recording unit. The central control unit 2 is connected to one or more vehicle components 4, such as a vehicle Controller Area Network (CANbus), vehicle ignition etc. In this example there is provided one or more sensors 6 such as a movement detector, a gyroscope, an accelerometer, a tyre pressure monitoring sensor, or an environmental monitoring sensor, such as an external temperature sensor.

[0119] The central control unit 2 is also connected to a vehicle driver interface, such as a mobile phone or interface for a mobile phone, a smartcard reader, or a keypad.

[0120] A global positioning system receiver 10 is operatively connected to the central control unit, and provides position data. A wireless communications link 12, which is a GPRS transceiver in this example but could equally be a GPRS, GSM, WiFi, Bluetooth, radio, satellite or other transceiver is connected to the central control unit and allows the central control unit to communicate bidirectionally with a central computing system, described below. The wireless communications link also support voice telephone calls between the driver or passengers of the vehicle and a telecommunications network.

[0121] A battery 14 is provided to power the central control unit and any of the other components requiring a power supply.

[0122] Figure 2 is a schematic diagram of a system for implementing the present invention. A centralised data processing centre 100 comprises a central computing system 102 which includes computer hardware and servers, executing one or more operating systems, data management applications, device management application and applications for bidirectional communication with in-vehicle devices 1. Telecommunications hardware 104 is provided for bidirectional communication with in-vehicle devices across a mobile telecommunications network 106.

[0123] Data received from in-vehicle devices, and data concerning customers and vehicles taking into account the data received is stored in a data store 108 which is operatively connected to the central computing system 102.

[0124] One or more data input computer systems 110 receive externally supplied data from electronic or human-input sources, such as data concerning used vehicle prices, data concerning the weather at a plurality of geographical locations and the like. Data received by data input computer systems is communicated to the central computing system 102 and also a billing and statement computer system 112, which functions as bill computation means. The billing and statement computer system is operatively connected to the data store from which it retrieves information required to calculate bills associated with vehicle leases.

[0125] The billing and statement computer system 112 is also operatively connected to an administration computer system 114, including user interfaces for receiving information and instructions concerning administration of the system.

The billing and statement computer system also drives a printing system 116 which prepares printed statements for sending to customers. The statement are a form of feedback. A payment collection system 118 receives information electronically or from human input, about bills which have been paid and relays this information to the billing and statement computer system. Web servers 120 are connected to the billing and statement computer system and to the internet 122. The web servers 120 provide a graphic user interface using well-known internet publishing techniques, protected by a customer authentication system. The customer authentication system requires a customer to input a userid and password before they can access information specific to that customer. The graphic user interface not only provides feedback to a customer in the form of information about costs associated with a lease, but also information about details used to calculate the cost, such as information measured by or derived from measurements made by in-vehicle sensors 6 and the in-vehicle global positioning system receiver 10.

[0126] In addition, the graphic user interface allows a user to input data concerning possible scenarios of future vehicle usage, using standard internet user interface tools such as menus, text entry boxes, buttons and the like. The web servers use information from the billing and statement system to provide cost estimates associated with the input scenarios.

Example data processing

[0127] The following illustration example concerns a car lease agreement.

[0128] A leasing company agrees to lease Vehicle A to customer B.

[0129] Vehicle A is determined to be worth £10,000 on Day 1 of a 1 year leasing agreement for customer B from a database of vehicle values.

[0130] Customer B advises the leasing company he expects to drive the vehicle 12,000 miles annually as he is a salesman, and so he uses the car regularly for business. The customer also advises the only other driver he expects to drive it will be his wife.

Based on this information and their current knowledge of car prices, the leasing company decides that Vehicle A will be worth £9,000 at the end of Year 1 assuming average wear and tear/damage to the vehicle they expect from the way vehicles are typically driven by a salesman. I.e. they expect the vehicle to depreciate in value due to damage by around £83 per month.

[0131] The leasing company deduces that it needs to charge a minimum of £1,000 during the leasing agreement to recoup its loss due to the depreciation from £10,000 to £9,000.

[0132] For this example, it is assumed that the leasing company wishes to make £200 profit a year on each leased vehicle. They would therefore at the start estimate the leasing fee for vehicle A at £1,000 plus £200 profit mark up, i. e. £1,200 for a year (£100 per month).

[0133] It is also assumed that customer B agrees with the leasing company to be monitored via an in-vehicle device and that his leasing fee will be charged accordingly based on a measure of the damage or risk of damage to the vehicle as a result of how he actually uses the vehicle. The factors used for this example will be as follows:

- Total mileage driven (measured by a connection to the vehicle odometer).
- Number of instances of harsh braking greater than threshold C (where threshold C is pre-determined by the leasing company) measured via a connection to the engine management system
- A measure of time spent driving in snowy/icy conditions (as this increases the risk of damage due to an accident and the roads are more likely to be "salted" and hence there is an increased risk of damage to the vehicle bodywork). This measure to utilise raw GPS positional data collected every 10 minutes when the vehicle ignition is on, plus external weather and mapping databases.

Step 1 - Raw Data collection by in-vehicle device

[0134] Vehicle A has an in-vehicle device 1 fitted, corresponding to that shown in Figure 1 and described above. The central control unit 2 has a clock for determining the date, and is attached to a vehicle CAN bus, from which it can receive information concerning ignition on and off events, and values of the vehicle odometer. The central control unit 2 is also operatively connected to an accelerometer for determining braking forces, and a global positioning system receiver 10 as described above.

[0135] For a single day, when 2 journeys are made, the raw data initially collected by the in-vehicle device might comprise:

Device X
Vehicle A
Date 13.10.03

Ignition on - odometer reading 1040.0, ignition off - odometer reading 1051.0
Ignition on - odometer reading 1051.0, ignition off - odometer reading 1087.6
Braking events - forces recorded 30.1, 33.1, 32.1, 39.1, 47.0, 29.0, 27.8, 56.4, 33, 32, 31, 29, 34, 48, 57, 29, 27, 33.5, 26, 29, 30, 31, 32, 31, 32, 31.1, 29.7
Location events shown as longitude and latitude with a timestamp:

07:04	51° 44' 52" N	000° 31' 12" E
07:14	51° 45' 03" N	000° 31' 13" E
07:24	51° 45' 11" N	000° 31' 13" E
07:34	51° 45' 12" N	000° 31' 13" E
07:44	51° 45' 12" N	000° 31' 12" E
Etc.	Etc.	Etc.

Step 2 - Processing within in-vehicle device and transmission to central computer

[0136] In this step, the raw data collected above undergoes some pre-processing in central control unit 2 before being transmitted to the central computing system 102, where it is stored in data store 108. The pre-processing includes the step of calculating the total distance travelled on that day from the raw data and also the number of harsh braking events over a pre-set threshold of 40.00 stored in the in-vehicle device 1. The data transmitted to the central computing system 102 might therefore be as follows:

Device X
Vehicle A
Date 13.10.03
Distance travelled 47.6 miles
4 harsh braking events recorded over threshold of 40.0
Location events as above:

07:04	51° 44' 52" N	000° 31' 12" E
07:14	51° 45' 03" N	000° 31' 13" E
07:24	51° 45' 11" N	000° 31' 13" E
07:34	51° 45' 12" N	000° 31' 13" E
07:44	51° 45' 12" N	000° 31' 12" E
Etc.	Etc.	Etc.

[0137] In this example data is transmitted from the in-vehicle device 1 to centralised data processing centre 100 via GPRS transceivers 12, 104.

Step 3 - Data consolidation for a period

[0138] On a regular basis (once a month in this example) the central computing system 102 takes all the daily data for Vehicle A and amalgamates the daily data into a monthly record stored in database 108. In this example, the computer would then hold a record of the total distance travelled in a month, plus total number of harsh braking events for the month, plus a data table containing all the position/location data for the month which might look something like this:

Device X
Vehicle A
Dates 1.10.03 to 31.10.03
Actual distance travelled 1,500 miles
20 harsh braking events recorded over threshold of 40.0
Location events table:

07:04	51° 44' 52" N	000° 31' 12" E

(continued)

07:14	51° 45' 03" N	000° 31' 13" E
07:24	51° 45' 11" N	000° 31' 13" E
07:34	51° 45' 12" N	000° 31' 13" E
07:44	51° 45' 12" N	000° 31' 12" E
Etc.	Etc.	Etc.

[0139] This amalgamated data is held in the temporary memory within the central computer before undergoing the next step.

Step 4 - Central computer attaches vehicle data to customer record

[0140] In step 4, the central computing system 102 attaches the amalgamated monthly data for device X/vehicle A to the customer record for Customer B, using a look-up table held in the central computer which matches device identifiers to customers.

[0141] The customer data attached to the vehicle record will comprise data which has been previously input by a human into a data input computer system 110 in response to questions asked of the customer and is required for billing purposes, such as:

- full name and address
- expected distance travel (in this example 1,000 per month)
- base leasing fee originally set for this vehicle (in this example, £100 per month)
- bank account sort code and account number

[0142] The combined data is then stored in temporary memory before going through the next step.

Step 5 - Matching to external databases and transfer to statement and billing system

[0143] In step 5, the position/location data within the combined data record output from step 4 is processed against external mapping and weather databases. This step first turns the raw longitude/latitude data into a position on a map with date/time of day shown at each position.

[0144] Then further processing then takes place by overlaying data from another external database (in this example a weather database) in order to identify what the weather was where the vehicle was driving.

[0145] A final step in the processing in this example is to count the number of "position points" where the vehicle was driven in icy or snowy conditions. In this example, we assume these total 15 points in the month 1.10.03 to 31.10.03. The fully processed and combined usage data is then transferred to the billing and statement computer system 112.

Step 6 - Bill calculation

[0146] The next step (carried out by the billing and statement computer system 112) is to calculate the bill for the period, a month in this example.

[0147] In this example, the leasing company knows that for 1,000 miles of average driving a month, the bill would be £100. The bill calculation step works out how much this particular vehicle differs from the average and uses this to work out a higher or lower charge for the period, depending on the results.

Original leasing fee for 1.10.03 to 31.10.03 1,500 actual miles less 1,000 expected miles = 500 extra miles	= £100.00
Assume charge per extra mile is £0.10 Therefore, additional charge due from customer of 500 x £0.10	= +£50.00
Actual number of harsh braking events was 20 Average number of harsh braking events assumed to be 25 Therefore, 20 - 25 = -5, i.e. 5 less harsh braking events than average Assume charge per harsh braking event is £0.50 Therefore credit due to customer of -5 x £0.50	= -£2.50
Number of position points recording usage in snowy/icy conditions was 15. The customer is charged £0.10 extra for each instance of driving in such conditions Therefore, additional charge due from customer is 15 x £0.10	= +£1.50
TOTAL MONTHLY CHARGE FOR 1.10.03 to 31.10.03	= £149.00

Step 7 - Payment collection and statement production

[0148] In this example, within this step the amount of £149.00 is deducted from the customer's bank account and the customer is sent a printed statement, produced by printing system 116, explaining how the fee was calculated.

[0149] This statement also provides feedback for Customer A to help him reduce his payment next time by reducing the damage and risk of damage to the vehicle. In this case the feedback would include explanatory text suggesting he does not use the car in snowy conditions (perhaps suggesting an alternative such as using the train) and also pointing out his mileage of 1,500 was 50% more than originally expected when he took out the lease.

[0150] The statement might also show an example of what would happen to his payments if he drove only 1,250 miles next month - in this case, assuming all other factors remain the same, his monthly bill would fall to £124.00.

[0151] The statement might also show the assumed current value of the car. This value was £10,000 at the start of the period and originally it was assumed to depreciate by £83 a month so the expected value of the car at the end of the first month was £9,917. However, due to the way the car has been used by Customer A it has depreciated further and so the company collected an additional £49 from the customer to allow for this increased damage. Assuming the second hand car market has not changed during the last period, the value of the vehicle at the end of the first month is therefore recalculated by the billing and statement system as £10,000 less £83 less £49 = £9,868.

Claims

1. A method of reducing damage, or the risk of damage, to a vehicle, comprising the steps of:

   using monitoring means to monitor one or more elements of vehicle usage associated with damage, or the risk of damage, to the vehicle or components thereof; and

   providing feedback to a user of the vehicle, calculated from one or more elements of vehicle usage monitored by the monitoring means and associated with damage, or the risk of damage, to the vehicle or components thereof.

2. A method according to claim 1, wherein the monitoring means comprise one or more sensors or electronic devices configured to measure information, or data about the vehicle, its environment, or usage of the vehicle.

3. A method according to claim 1 or 2, wherein the monitored elements of vehicle usage comprise one or more of the following: the distance travelled by the vehicle; the time the vehicle spends with the engine running; the time the vehicle spends moving; the time the vehicle spends stationary with the engine on; the time the vehicle spends stationary with the engine off; the amount of time or incidence of harsh braking and/or acceleration, preferably as a portion of driving time; engine speed, for example as revolutions per minute; the sideways acceleration/g-forces experienced when the vehicle is cornering; the frequency and pattern of gear changes; the proportion of time spent in particular gears; the number of times and frequency of skidding by the vehicle; the speed at which the vehicle is driven, both absolutely and in comparison to the speed limit in force at the location where the vehicle is determined to be; the location where the vehicle is parked and/or kept, particularly at night; the frequency and amount of driving of the vehicle in adverse weather conditions; the style of driving of a user in specific weather conditions, including temperature conditions; deployment of airbag; the number of occupants of the vehicle; the number of occupied seats in the vehicle; the total weight of the occupants and/or their luggage and/or the overall weight of the vehicle; tyre pressures; type of road which the vehicle travelled down and/or other characteristics of the road, such as characteristics of the road surface; the time of day of use; whether a tow bar is being used; the weight of a load being towed; which user of several specified users is driving the vehicle.

4. A method according to claim 1, 2 or 3, wherein feedback is provided responsive to computation carried out by computing means, the computing means comprising central computing means configured to receive data from a plurality of vehicles, and send feedback to the vehicle or a user thereof, and/or carrying out computational steps on the received data.

5. A method according to claim 5, wherein computing means comprises central computing means and in-vehicle computing means, each operably connected to communications apparatus for two-way communication therebetween.

6. Apparatus for reducing damage, or the risk of damage, to a vehicle, comprising:

monitoring means for monitoring one or more elements of vehicle usage associated with damage, or the risk of damage, to the vehicle or components thereof;

computing means for determining feedback to be provided to a user of the vehicle from data provided by monitoring means;

and communication means for communicating feedback to the user of the vehicle.

7. Apparatus according to claim 6, wherein monitoring means comprise one or more sensors configured to measure information about the vehicle, its environment or usage.

8. Apparatus according to claim 6 or 7, wherein the monitoring means are partially or entirely external to the vehicle.

9. Apparatus according to claim 6, 7 or 8, wherein the monitoring means include means to determine at least the location of the vehicle and the time when the location of the vehicle is determined.

10. Apparatus according to any one of claims 6 to 9, wherein the monitoring means includes a receiver for a satellite-based positioning system.

11. Apparatus according to any one of claims 6 to 10, wherein the computing means comprises an in-vehicle computing device.

12. Apparatus according to any one of claims 6 to 11, wherein the computing means comprises a central computing system configured to carry out calculations in respect of the usage of one or more vehicles.

13. A computing device for use in a vehicle, comprising: at least one input for receiving, from monitoring means, data concerning one or more elements of vehicle usage associated with damage, or the risk of damage, to the vehicle, or components thereof; computing means operable to determine feedback to be provided to a user of the vehicle calculated dependent on the received data; and at least one output for providing the feedback to a user in the vehicle.

14. A computing device for use in a vehicle, comprising at least one input for receiving, from monitoring means, data concerning one or more element of vehicle usage associated with damage, or the risk of damage, to the vehicle, or components thereof; two-way communication means configured to transmit the received data, or data derived therefrom, to computing means remote from the vehicle and to receive therefrom remotely-calculated data; the remotely-calculated data being calculated taking into account the transmitted data; and output means for providing feedback to a user in the vehicle, the feedback being determined taking into account the received remotely-calculated data.

15. A vehicle comprising a computing device as claimed in claim 13 or 14.

16. Computer software comprising program code means which, when executed on a computer, cause it to function as the computing device of claim 13 or 14.

17. Computer software comprising program code means which, when executed on one or more computers, cause them to function as a central computing means, operable to receive data from a plurality of vehicles, the data comprising or being derived from measurements made by monitoring means of one or more elements of vehicle usage associated with damage, or the risk of damage, to each vehicle or components thereof; and to calculate therefrom feedback for provision to the users of each vehicle.

18. A vehicle, provided for sale, hire, rental or lease and having associated therewith data available to a potential purchaser indicative of past usage of the vehicle, derived from measurements made during previous usage of the vehicle by monitoring means for monitoring one or more elements of vehicle usage associated with wear, or the risk of wear, to the vehicle or components thereof, including at least one element of vehicle usage other than the total distance travelled by the vehicle.

Fig.1.

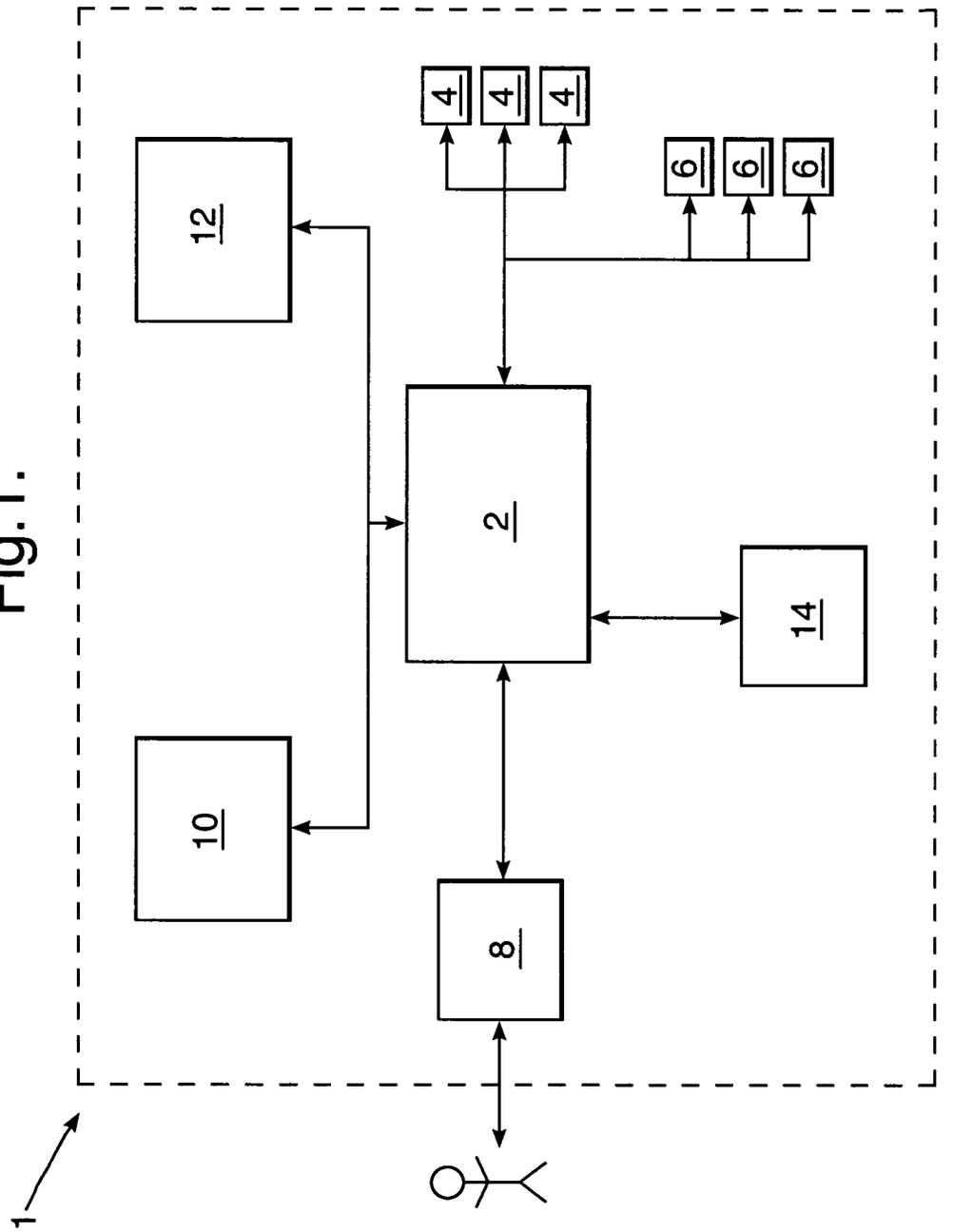

Fig.2.