METHOD AND APPARATUS FOR DISTANCE MEASUREMENT

A method of recording distance travelled, comprising: using a satellite tracking device to record location data comprising a sequence of vehicle locations; uploading the location data via a network to a remote database; generating, from the location data, trip data comprising the trips undertaken by the vehicle; assigning at least one trip of the trip data as business related; and recording a travel claim on the remote database, based on the trip data that has been assigned as business or personal or private or non-business related. A computer comprising a user interface, wherein the computer is configured to upload data from a portable satellite tracking device to a remote database hosted on a server, and the user interface is operable to: generate, from the location data, trip data comprising the trips undertaken by the vehicle, storing the trip data on the remote database; assign a trip from the trip data as business related or non-business related; record a travel claim on the remote database based on the trip data. A system comprising the computer and a portable satellite tracking device.
Method and apparatus for distance measurement

The present invention relates to a method and apparatus for distance (or mileage) measurement. More specifically, the present invention relates to a method and apparatus for measuring and recording a distance travelled in a vehicle, and calculating compensation arising therefrom.

It is common for employees to use vehicles (such as cars or vans) in the course of their employment, for example, in attending meetings, making deliveries or visiting clients. Under such circumstances it is common for the employer to contribute to the expense of running the vehicle, for instance by providing a company vehicle for the use of the employee, or by contributing towards the running costs of an employee's vehicle. In the UK, rules are provided by Her Majesty's Revenue and Customs (HMRC) governing the payment of such compensation.

It is desirable to keep records of the trips made by a vehicle which may be used for business purposes. Such records can be used to determine the business related distance travelled, so that the appropriate levels of compensation may be paid to the employee. Such information may also be used to determine the total distance travelled, for instance to allow a leased vehicle to be returned before it exceeds a predetermined mileage.

It is known to use a satellite tracking device (GPS, GLONASS etc) to track the movements of a vehicle for the purpose of determining business related mileage. For example, mobile phone applications such as Triplog (available from the Google Play store) and Automilez (available from the iTunes® app store) are commonly used. These applications can be used to record business related mileage using a smartphone. It is well known that enabling satellite based geolocation on a smartphone has a potentially significant impact on battery life, typically limiting phone life to less than around 4 hours.

Telematics devices are also known, in which a satellite tracking device is permanently installed in a vehicle to allow its usage to be monitored. However, such devices are generally expensive to install, and not usually suitable for measuring mileage in employee owned vehicles.
It is an objective of this invention to improve the accuracy and ease of recording distance (mileage), and more specifically business related distance, travelled by a vehicle. It is a further objective of the invention to improve management oversight of business related distance recording and the accuracy of mileage claims.

According to a first aspect of the present invention there is provided a method comprising: using a satellite tracking device to record location data comprising a sequence of vehicle locations; uploading the location data via a network to a remote database; generating, from the location data, trip data comprising the trips undertaken by the vehicle; assigning at least one trip of the trip data as business or personal or private or non-business related; and recording a travel claim on the remote database, based on the trip data that has been assigned as business or personal or private or non-business related.

The satellite tracking device may be portable. The word "portable" in this context means that the tracking device need not be installed by a specialist technician or anyone with specialist knowledge within the vehicle, but may instead be easily transferred or transported between vehicles by the user of the device, for example by hand, and preferably without using tools.

The network may be a wide area network, a mobile network or else correspond to, or otherwise comprise part of the Internet.

The uploading may comprise transferring location data from the satellite tracking device to a computer, processing the location data at the computer, and transferring the processed location data from the computer to the remote database.

Processing the data may comprise correcting errors in the data; and/or removing sequences of similar or identical locations, corresponding to the vehicle being stationary. Processing the location data may comprise translating the data from a binary format to a textual format.

The remote database may be hosted on a server. The server may be a web server. The server may be a virtual machine. The virtual machine may be a virtual private server.
The assigning may be carried out by a user via a user application that interfaces with the remote database. The assigning may be automatic, based on the locations comprising each trip data. The user application may comprise a website that accesses the remote database.

The travel claim may be a mileage claim. The travel claim may be calculated in reliance on the distance travelled during the business-related trips.

The method may further comprise approving the travel claim. The approving may be carried out by a user via the user application. The approved travel claim may be recorded in the remote database.

The method may further comprise paying the travel claim. Payment of the approved travel claim may be automatic, being based on the approved travel claim recorded on the remote database.

A plurality of satellite tracking devices may be used to record location data for a plurality of vehicles, and the data from the plurality of satellite tracking devices may be uploaded to a single remote database.

The method may further comprise analysing the trip data corresponding with a time period to determine: what locations were visited by a particular vehicle during the time period; how often each location was visited by a particular vehicle during the time period; and/or how long the vehicle was at each location during each visit.

The method may further comprise analysing the trip data to assess the risk associated with the usage of each vehicle, based on at least one risk factor. The risk factors may comprise: total travel in a period, trips during unsociable hours (early morning or late evening), frequency of rest breaks, and/or type of roads travelled on.

The method may further comprise analysing the trip data to determine maintenance requirements for at least one vehicle. The total distance travelled (including both business and non-business mileage) may be monitored, and the method may include automatically scheduling maintenance for the vehicle in reliance on the location data on the remote database.
The method may further comprise reporting or transmitting trip data and/or associated information (e.g. accurate trip details) to a taxation authority, such as HM Revenue and Customs in the UK or the IRS in the USA or the National Tax Agency in Japan etc. By 'taxation authority' we mean any governmental body, or other authorised entity, which has the power to calculate, collect and enforce taxation within the country of interest.

The method may further comprise reporting or transmitting trip data and/or associated information (e.g. accurate trip details) to a payroll department of an employee's company, so that the corresponding tax and/or national insurance contributions (NIC) deductions (i.e. 'taxable deductions') can be calculated and accounted for.

According to a second aspect of the invention, there is provided a computer comprising a user interface, wherein the computer is configured to upload data from a portable satellite tracking device to a remote database hosted on a server, and the user interface is operable to: generate, from the location data, trip data comprising the trips undertaken by the vehicle, storing the trip data on the remote database; assign a trip from the trip data as business related or non-business related; record a travel claim on the remote database based on the trip data.

The user interface may be configured to allow a user to approve a travel claim recorded on the remote database.

The computer may be comprised within a smartphone or tablet.

The computer may be configured to download data from the satellite tracking device via a serial driver, and/or via a wireless communication system. The wireless communication system may be Bluetooth compatible.

The computer may be configured with a bridge which is operable to provide data connectivity between the user interface and the serial driver.

The bridge may be implemented in a high level programming language, such as C.
The user interface may be operable to perform management of the remote database comprising at least one of: editing or adding of users, named locations, vehicles, mileage rates and/or vehicle data.

The user interface may be operable to report a claim history for one or more users.

The user interface may be provided by an application written for a cross-platform run time. The cross-platform runtime may be Adobe AIR. Using a cross platform runtime allows the application to run on multiple platforms without re-writing the code. For example, code written for Adobe AIR can run under Windows, OS X, Android and iOS. The user interface may be a website or web portal. The bridge may provide a robust interface between a user interface program in Adobe AIR and a serial driver.

According to a third aspect of the invention, there is provided a vehicle usage monitoring system comprising a portable satellite tracking device, and a computer according to the second aspect.

According to a fourth aspect of the invention, there is provided software encoded on a data carrier, which when executed on a computer, is operable to upload data from a portable satellite tracking device to a remote database hosted on a server, and to provide a user interface operable to: generate, from the location data, trip data comprising the trips undertaken by the vehicle, storing the trip data on the remote database; assign a trip from the trip data as business related or non-business related; record a travel claim on the remote database based on the trip data.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a diagram of a method according to an embodiment of the invention;

Figure 2 is a photograph of a satellite tracking device according to an embodiment of the invention; and

Figure 3 is a diagram showing the process by which data is downloaded from the satellite tracking device, according to an embodiment of the invention.
Referring to Figure 1, an exemplary method 10 is depicted for recording travel claims. The method starts with a step of recording location data 3, using a satellite tracking device 20 (shown in Figure 2). The user deploys the portable satellite tracking device in the vehicle that they are using, and the tracking device 20 records the successive locations of the vehicle. The tracking device 20 is preferably a portable device, which can be installed by simply plugging it into a 12V or 5V vehicle power outlet such as cigarette lighter socket or a USB port. The portable tracking device can thereby be easily deployed within a range of different vehicles as required. An example of a satellite tracking device 20 according to the invention is shown in Figure 2.

The satellite tracking device 20 of Figure 2 is a USB dongle type device, comprising a male type A USB connector, with a removable cap 22 for covering the connector when it is not in use. The USB dongle comprises a GPS antenna, and is configured to periodically determine and store a location based on GPS satellites. The satellite tracking device 20 has a large number of correlators/channels (for example more than 60) to enable it to rapidly obtain a GPS fix, and to maintain position tracking in difficult scenarios such as urban canyons (which tend to obscure satellites from view). The satellite tracking device 20 is capable of operating within a vehicle in a central location, remote from the vehicle windows.

The satellite tracking device 20 is configured to record position every 5 seconds, and comprises enough memory to store at least three months of location data with continuous operation (~1.6M positions). The satellite tracking device 20 may be powered via the USB connector, and/or may comprise a re-chargeable battery from which it derives power. The satellite tracking device 20 may comprise a wake-up sensor, such as a vibration or acceleration sensor, that prompts the tracking device to begin recording location data.

Returning to Figure 1, when the tracking device 20 has been recording location data for a period of time, its memory will comprise a sequence of vehicle locations, corresponding to trips undertaken by the user in a vehicle (or multiple vehicles).

When the user wishes to review their trips, for example so that they can make a mileage claim, the user connects the tracking device to a computer 9 so that the data may be downloaded 4 from the tracking device to the computer 9.
The computer 9 may comprise a personal computer such as a desktop or laptop, with a Windows or OS X operating system. Alternatively the computer may be in the form of a smartphone or tablet with an Android or iOS operating system. The computer 9 is configured with a client application that allows the user to download location data 4 from the tracking device 20, process the location data 5, and upload 6 the location data to a remote central database 12, external to the computer 9. The location data comprises trips that the user has made.

The computer 9 is further provided with a user interface application, which may comprise the client application, which allows trips to be identified from the location data on the remote database 12. The user interface application allows each trip to be assigned 7 by the user as business related or non-business related. The trip data and the assignment of each trip is stored on the remote database 12. Having assigned each trip as business or non-business related, the user may then use the user interface application to submit a mileage claim for the distance travelled on trips that are business related. The mileage claim is stored on the remote database for subsequent approval by a manager. The user interface application may comprise a website, and may be accessed from a different computer than the client application.

The user interface application provides management functions 13, that allow a manager to review data on the remote database 12. The management functions 13 allow the manager to review 14 and approve 15 mileage claims that have been submitted by a user (or users), as well as produce reports 16.

In order to make the user interface able to run on as many platforms as possible, the user interface may be an application implemented in Adobe AIR. This allows a homogenous user interface across platforms and enables the user interface to be easily managed and updated. However, Adobe AIR lacks native support for connecting to a serial driver to obtain data therefrom. Both a user interface based on an application, and a user interface based on a website may be provided for the user, and these may have a homogenous user interface.

In order to enable the user interface to connect to the serial driver, a bridge may be provided for connecting from the user interface 17 to the serial driver 23 so that the user interface 17 can access the data on the connected tracking device 20. This is
illustrated in Figure 3, which shows how the user interface 17 requests data from the connected tracking device 20, and how the data is passed from the tracking device 20 to the user interface 17 in response.

The connection between the tracking device 20 and computer 9 may be achieved by simply connecting the tracking device 20 via a USB port of the computer 9. Alternatively, the tracking device 20 may be wirelessly connected to the computer 9, for instance by Bluetooth. Downloading of data from the tracking device 20 to the computer 9 may be automatic, and optionally, uploading from the computer to the remote database may also be automatic. The user interface application may be configured to download data from the tracking device 20 and/or upload data to the remote database if a pre-determined period has elapsed since the last download or upload respectively. Such scheduled downloading may be particularly advantageous when the computer is a mobile device, which is frequently in wireless communications range with the installed portable tracking device in the vehicle.

Operating systems such as OS X and Windows include serial drivers for connecting to the tracking device 20, which is recognised as a serial drive. The bridge between the user interface component 17 and the serial driver 23 for the tracking device comprises a C extension 19 and an extension interface 18. Both the C extension 19 and extension interface 18 are written in C, in order to work with a wide range of operating systems. The C extension 19 requests and receives data directly from the serial driver 23, and records the data as native C binary objects. The extension interface 18 translates the native C binary objects into binary ByteArrays which can be used by Actionscript in Adobe AIR.

The location data is subsequently validated by the user interface component of the client application, cleansed and translated before being encrypted and transferred to the remote database 12, which is conveniently hosted on a webserver 11.

During translation, the user interface application swaps the orders of the ByteArrays from being Little Endian to Big Endian. The location data is then read, one entry at a time. The data, which is now in hex format, is subsequently joined together in groups of an appropriate size (16 or 32 bits) in order to make a single unit. Each single unit is then interpreted as text and translated into either a LONG GPRS reference (with a full
date time stamp), or a SHORT GPS reference (giving an offset from the previous LONG). The client application constantly maintains a check for both race conditions and buffer overflows as any loss of data or missed messages may destroy the interpretive chain and mean that the sequence needs to be re-started.

The cleaning of the data involves optimisation to ensure that only the necessary data is retained, for instance by de-duplication of repeat entries that may occur when the tracking device is static over a period of time. Static parts of trips can be sent as a single LONG GPRS reference given the location of the stop.

The location data is then converted to Java script object notation, for sending to the webserver 11 that hosts the remote database 12.

The location data is processed to extract trip data from the location data by the client application on the computer 9 before it is uploaded to the remote database 12. Both raw location data and trip data may be stored on the remote database.

The user interface application, and/or the web based user interface, allow the user to use the trip data on the remote database to create and submit and mileage claim. The user may first select a date period of trips required, and the user interface report the trips that fall within the date range, so that the user can review each trip so that the trips may be assigned as business, or non-business related.

In order to facilitate this reviewing process, the user interface (client application or web based) may use a web based mapping application programming interface (API) to display the trip on a map by reverse geocoding. In a preferred embodiment, Google Maps is used for this purpose, and the trip displayed on Google Maps/Earth. The trip data may be corrected via reverse geocoding. For instance, offsets from roads and addresses may be corrected to the nearest road or address location. Where a gap in data exists, Google Maps may be used to find a route and associated distance between the known locations at either side of the gap in the data. Similarly, a delay in acquisition of a GPS fix can be corrected by assuming that the start of a trip is from the end of the previous trip, or from a known location (such as home or office location) and calculating the route accordingly.
The user interface allows the mileage of each trip to be adjusted, for example to remove mileage associated with a detour undertaken for non-business reasons. For each trip, the user is able to flag whether the trip is business related or not. A reason for each trip can be assigned by the user (for example "visiting client xxx"). Client data can be stored on the remote database, and trips associated with clients. Association of trips with clients may be automatic, based on client data and the trip location data. Client data may comprise client name, and client address. Manual trips can also be added that have not been recorded by the tracking device 20.

The final claim includes all of the trips that are assigned as business related, including any client names and reasons for the trips. The final claim may be saved, exported (for example to a .csv or .xls or .xlsx file), printed, or submitted for authorisation. Claims submitted for authorisation are recorded by the remote database 12 for subsequent review.

The user interface also allows a manager to review and authorise, query or reject claims that have been submitted, which are stored on the remote database. The manager can provide a feedback when querying or rejecting a mileage claim. The user who submitted a queried or rejected claim is notified, and given the opportunity to edit the claim and re-submit it.

In addition to storing location and trip data, the remote database can store driver information, which may be input via the user interface (whether client application based, or web based). Driver information comprises at least one of: name; job title, address, contact number, mileage reimbursement type, driver grade, mileage rate, cost centre. Similarly, client information may be input and stored. Client information comprises at least one of: name, address, notes, date created. Location information may be input and stored, comprising at least one of: friendly name, address, post code. Vehicle information may be input and stored, comprising at least one of: registration number, make, model, colour, body style, engine capacity, fuel type, CO₂ emissions per mile or km, date registered, total mileage travelled. Reminders may be set.

Access to the database may require authentication, such as a username and password.
The database and/or user interface may be configured to produce reports. Reports may comprise information such as: the highest business mileage users, the lowest business mileage users, the total business mileage over time (for example in the form of a graph), C0₂ emitted by business related vehicle use over time (e.g. as a graph), users with highest C0₂ emissions, users with lowest C0₂ emissions. Consolidated mileage reports may be produced, comprising: all users, company vehicles, private vehicles. Full user reports may be produced for selected individuals, filtered by all/pending/submitted/approved/queried/paid/rejected. The reporting period for any report may be adjusted, for example month/quarter/6 months/year/2 years.

The use of a system and method according to the invention can result in large monetary savings. It has been estimated that 25% of mileage claims are typically fabricated or over-estimated. In the UK, HMRC may impose a significant fine on the employer if more than 20% of drivers produce poor mileage records. It has been reported that 40% of companies that have been checked have unacceptable mileage records.

The central management of data according to the system and method of the present invention provides for a robust system of recording, submitting and approving mileage claims. The use of a removable or portable satellite tracking system means that there is less resistance from users to installing the device in their own vehicles. The ability of the tracking device to record over large periods, under challenging conditions allows the user to simply plug the device in, and forget about it until they need to make a claim.

The skilled person will appreciate that a number of modifications to the example embodiments are possible, without departing from the scope of the invention, as defined by the appended claims.
Claims

1. A method of recording distance travelled, comprising: using a satellite tracking device to record location data comprising a sequence of vehicle locations; uploading the location data via a network to a remote database; generating, from the location data, trip data comprising the trips undertaken by the vehicle; assigning at least one trip of the trip data as business or personal or private or non-business related; and recording a travel claim on the remote database, based on the trip data that has been assigned as business or personal or private or non-business related.

2. The method of claim 1, wherein uploading comprises transferring location data from the satellite tracking device to a computer, processing the location data at the computer, and transferring the processed location data from the computer to the remote database.

3. The method of claim 2 wherein processing the data comprises one or more of: (i) correcting errors in the data; (ii) removing sequences of similar or identical locations, corresponding to the vehicle being stationary; and (iii) translating the data from a binary format to a textual format.

4. The method of any preceding claim, wherein the remote database is hosted on a server.

5. The method of claim 4, wherein the server is: a web server; a virtual machine; and/or a virtual private server.

6. The method of any preceding claim, wherein the assigning is automatic, based on the locations comprising each trip data.

7. The method of any preceding claim, wherein assigning is carried out by a user via a user application that interfaces with the remote database.

8. The method of claim 7, wherein the user application comprises a website that accesses the remote database.
9. The method of any preceding claim, wherein the travel claim is a mileage claim; and/or is calculated in reliance on the distance travelled during the business-related trips.

10. The method of any preceding claim, further comprising approving the travel claim.

11. The method of claim 10, wherein approving is carried out by a user via a user application.

12. The method of claim 10 or 11, further comprising automatically paying the travel claim, based on the approved travel claim recorded on the remote database.

13. The method of any preceding claim, wherein a plurality of satellite tracking devices are used to record location data for a plurality of vehicles, and the location data from the plurality of satellite tracking devices is uploaded to the remote database.

14. The method of any preceding claim, further comprising analysing trip data corresponding with a time period to determine at least one of: what locations were visited by a particular vehicle during the time period; how often each location was visited by a particular vehicle during the time period; and how long the vehicle was at each location during each visit.

15. The method of any preceding claim, comprising analysing the trip data to assess the risk associated with the usage of each vehicle, based on at least one risk factor.

16. The method of claim 15, wherein the risk factors comprise at least one of: total travel in a time period, trips during unsociable hours, frequency of rest breaks, and type of roads travelled on.

17. The method of any preceding claim, further comprising analysing the trip data to determine maintenance requirements for at least one vehicle.
18. The method of claim 17, comprising automatically scheduling maintenance for the vehicle in reliance on the location data on the remote database.

19. The method of any preceding claim, comprising reporting or transmitting the trip data to a taxation authority.

20. The method of any preceding claim, comprising reporting or transmitting the trip data to a payroll department.

21. The method of Claim 20, further comprising calculating at least one taxable deduction based on the reported or transmitted data.

22. A computer comprising a user interface, wherein the computer is configured to upload data from a portable satellite tracking device to a remote database hosted on a server, and the user interface is operable to: generate, from the location data, trip data comprising the trips undertaken by the vehicle, storing the trip data on the remote database; assign a trip from the trip data as business related or non-business related; record a travel claim on the remote database based on the trip data.

23. The computer according to claim 2, wherein the user interface is configured to allow a user to approve a travel claim recorded on the remote database.

24. The computer according to claim 22 or 23, wherein the computer is comprised within a smartphone or tablet.

25. The computer according to any of claims 22 to 24, wherein the computer is configured to download data from the satellite tracking device via a serial driver, and/or via a wireless communication system.

26. The computer according to claim 25, wherein the computer is configured with a bridge which is operable to provide data connectivity between the user interface and the serial driver.

27. The computer according to claim 26, wherein the bridge is implemented using C.
28. The computer according to any of claims 22 to 27, wherein the user interface is operable to perform management of the remote database comprising at least one of: editing or adding of users, named locations, vehicles, mileage rates and/or vehicle data.

29. The computer according to any of claims 22 to 28, wherein the user interface is operable to report a claim history for one or more users.

30. The computer according to any of claims 22 to 29, wherein the user interface is provided by an application written for a cross-platform run time.

31. A vehicle usage monitoring system comprising a portable satellite tracking device, and a computer according to any of claims 22 to 30.

32. Software encoded on a data carrier, which when executed on a computer, is operable to upload data from a satellite tracking device to a remote database hosted on a server, and to provide a user interface operable to: generate, from the location data, trip data comprising the trips undertaken by the vehicle, storing the trip data on the remote database; assign a trip from the trip data as business related or non-business related; record a travel claim on the remote database based on the trip data.

33. A method substantially as hereinbefore described, with reference to the accompanying drawings.

34. A computer substantially as hereinbefore described, with reference to the accompanying drawings.

35. A system substantially as hereinbefore described, with reference to the accompanying drawings.
Figure 3
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01C22/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G01C G06Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>column 1, line 7 - column 1, line 28; figures 1-5</td>
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Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "B" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or whether the invention was actually made before the priority date claimed
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
- "S" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "T" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "U" document member of the same patent family
- "A" document member of the same patent family

Date of the actual completion of the international search: 11 June 2014

Date of mailing of the international search report: 18/06/2014

Name and mailing address of the ISA/
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV RIJSWIJK
Tel. (+31-70) 340-2040
Fax: (+31-70) 340-3016

Authorized officer: van Doornum, A
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