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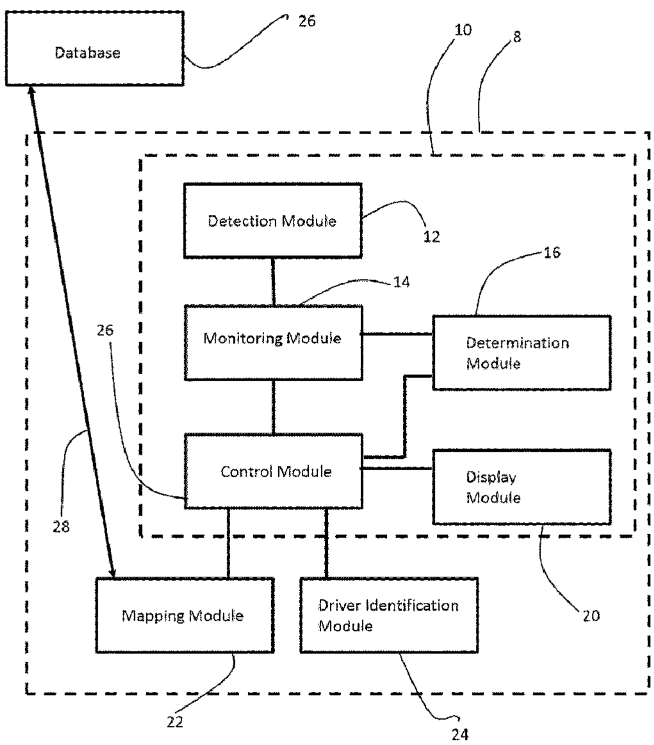

Figure 1

(57) Abstract: The present invention relates to a fuel system for a vehicle, comprising a detection module arranged to detect a fuel usage parameter. The fuel system comprises a monitoring module arranged to monitor the fuel usage parameter over time to determine a fuel usage trend. The fuel system comprises a control module arranged to provide a refuelling instruction to a vehicle user based on the fuel usage trend.

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VEHICLE FUEL SYSTEM

TECHNICAL FIELD

The invention relates to a vehicle fuel system and more specifically to those fuel systems providing a refuelling instruction to the driver of the vehicle.

BACKGROUND

A typical vehicle fuel system for a car or the like includes a fuel tank having a variable fuel level. A fuel sensor is provided inside the tank. The fuel level sensor is arranged to determine the level of fuel for any given point in time. The fuel level sensor is communicatively linked to a monitoring module arranged to monitor the fuel level over time. A control module is usually provided which provides a refuelling instruction to a display typically provided on the dashboard.

The refuelling instruction is configured to prompt a driver to refuel the vehicle when the fuel level drops below a predetermined threshold. A typical predetermined threshold is fixed and may be when there is only enough fuel left in the tank for,say, 50 miles worth of travel.

Such refuelling instructions are often ignored because the driver of the vehicle does not always find them to be timely.

It is an object of embodiments of the invention to at least mitigate one or more of the problems of the prior art.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention there is provided a fuel system for a vehicle, comprising; a detection module arranged to detect a fuel usage parameter; a monitoring module arranged to monitor the fuel usage parameter over time to determine a fuel usage trend; and a control module arranged to provide a refuelling instruction to a vehicle user based on the fuel usage trend.

The fuel usage trend allows for the refuelling instruction to be more accurate according to the habitual usage of the vehicle. This means that the refuelling instruction is less likely to be ignored for example and thus reduces the risk of the vehicle running out of fuel during use.

The detection module may comprise a fuel level sensor.

The fuel usage parameter may include a fuel level at which a user refuels. Such an arrangement means that the refuelling instruction is only provided at a point when the driver would usually want to refuel and as such the instruction is likely to be followed.

The fuel usage parameter may include fuel usage rate.

The vehicle fuel system may comprise a determination module for determining a future fuel usage prediction based on the fuel usage trend.

The refuelling instruction may be based on the future fuel usage prediction. In such an arrangement, the system can provide the refuelling instruction if there is likely to be insufficient fuel for a forthcoming journey typically taken by a vehicles driver.

The control module may be arranged to communicate with a mapping module for providing a mapping input to the control module, wherein the control system may be arranged to verify the refuelling instruction based on a mapping input. Verifying the refuelling instruction avoids providing refuelling instructions where they may not be appropriate.

The mapping input may include refuelling location data.

The mapping input may include traffic density data. Such mapping inputs enable assessment of the practicality of providing a refuelling instruction for example in the cases where a refuelling location is on route to a future habitual destination, thus avoiding a redundant trip and also the case where a traffic jam on route to a refuelling location would warrant the delaying refuel to a later time.

The control module may be arranged to receive driver identification information from a driver identification module and determine a fuel usage trend specific to each driver.

In the case where a vehicle has multiple drivers, each driver may opt to refuel at different points. Creating a fuel usage trend for each driver means that the refuelling instruction is specific to the driver driving the vehicle at that point in time.

According to a further aspect of the present invention there is provided a vehicle comprising the aforementioned vehicle fuel system.

According to a further aspect of the present invention there is provided a method of automating a refuelling instruction, comprising the steps of detecting a fuel usage parameter; monitoring the fuel usage parameter over time; determining a fuel usage trend based on the fuel usage parameter over time; and providing a refuelling instruction based on the fuel usage trend.

The step of detecting the fuel usage parameter may comprise the step of detecting a fuel level at which the vehicle user refuels.

The step of detecting the fuel usage parameter may comprise the step of detecting a fuel usage rate.

The method may comprise the step of predicting the future fuel usage and providing the refuelling instruction based on the future fuel usage prediction.

The method may comprise the steps of obtaining a mapping input and verifying the refuelling instruction based on the mapping input.

Obtaining the mapping input may comprise obtaining refuelling location data.

According to a further embodiment of the present invention there is provided a navigation system for a vehicle comprising a mapping module including a set of refuelling locations, the mapping module arranged to determine the position of the system relative to the fuelling locations; a learning module arranged to learn the refuelling locations most frequented by the vehicle; and a communication module arranged to obtain a selective set of fuel parameters relating to the most frequented refuelling locations.

Downloading only a selective set of fuel parameters based on the most frequented fuelling locations reduces the burden on the hardware of the navigation system, for example, a reduced amount of memory is required, the data set is a lot smaller than a blanket update and so the update time together with data usage when updating fuel parameters is improved.

The navigation system may comprise a display module arranged to display the fuel parameters and the most frequented refuelling locations on an E-map. Displaying the fuel parameters in the most frequented refuelling locations on the E-map is advantageous from the drivers point of view since all of the information (e.g. refuelling location and fuel parameters) is contained in one location.

The fuel parameters may be displayed on the E-map at the locations of the respective refuelling location. Displaying the fuel parameters at the locations of the respective refuelling locations further improves the impact on the driver since the relevant information has been matched up.

The communication module may be arranged to download the refuelling parameters over an electromagnetic medium. Downloading the fuel parameters over an electromagnetic medium is advantageous because the update of the fuel parameters can be undertaken without removing the navigation system from the vehicle to plug it into an external PC.

The electromagnetic medium may be selected from the list, but not limited to Wi-Fi, 3G, and 4G. Wi-Fi, 3G and 4G allow for the update to be undertaken automatically whilst the vehicle is in use. The selective downloading fuel parameter is particularly important with such electronic media since with such media it is often desirable to reduce the data usage during download.

The fuel parameters may be selected from the list of fuel price, fuel brand, fuel type, fuel availability and fuel quantity.

The learning module may be arranged to communicate with a driver identification module to identifying a driver of the vehicle, the learning module being arranged to learn the refuelling locations most frequented by the vehicle when the identified driver is driving. This is particularly advantageous where there is more than one driver of the vehicle using the navigation system. In such a case, the driver using the vehicle at any given time will be able to access the respective fuel parameters relevant to the most frequented refuelling locations.

The communication module may be arranged to obtain the selective set of fuel parameters relating only to the most frequented refuelling locations associated with the identified driver of the vehicle.

According to a further aspect of the present invention there is provided a vehicle comprising the aforementioned navigation system.

According to a further aspect of the present invention there is provided a method of maintaining a navigation system for a vehicle, the method comprising;

providing refuelling location information;

determining a position of the system relative to the refuelling locations;

learning the refuelling locations most frequented by the vehicle; and obtaining a selective set of fuel parameters relating to the most frequented refuelling locations.

The method may comprise displaying the fuel parameters and the refuelling locations most frequented by the vehicle on an E-map.

The method may comprise the step of displaying the fuel parameters on the E-map at the locations of the refuelling locations most frequented by the vehicle.

The method may comprise the step of obtaining driver identification information and learning the refuelling locations most frequented for the identified driver of the vehicle.

The method may comprise the step of obtaining a selective set of fuel parameters relating to the most frequented refuelling locations for the identified driver of the vehicle.

For purposes of this disclosure, it is to be understood that the control, monitoring, detection, mapping, learning and communication modules described herein can each comprise a control unit or computational device having one or more electronic processors.

A vehicle and/or a system thereof may comprise a single control unit or electronic controller or alternatively different functions of the modules may be embodied in, or hosted in, different control units or controllers.

As used herein, the term “control unit” will be understood to include both a single control unit or controller and a plurality of control units or controllers collectively operating to provide the required control functionality.

A set of instructions could be provided which, when executed, cause said controller(s) or control unit(s) to implement the control techniques described herein (including the method(s) described below). The set of instructions may be embedded in one or more electronic processors, or alternatively, the set of instructions could be provided as software to be executed by one or more electronic processor(s). For example, a first controller may be implemented in software run on one or more electronic processors, and one or more other controllers may also be implemented in software run on or more electronic processors, optionally the same one or more processors as the first controller. It will be appreciated, however, that other arrangements are also useful, and therefore, the present invention is not intended to be limited to any particular arrangement. In any event, the set of instructions described above may be embedded in a computer-readable storage medium (e.g., a non-transitory storage medium) that may comprise any mechanism for storing information in a form readable by a machine or electronic processors/computational device, including, without limitation: a magnetic storage medium (e.g., floppy diskette); optical storage medium (e.g., CD-ROM); magneto optical storage medium; read only memory (ROM); random access memory (RAM); erasable programmable memory (e.g., EPROM ad EEPROM); flash memory; or electrical or other types of medium for storing such information/instructions.

Within the scope of this application it is expressly intended that the various aspects, embodiments, examples and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings, and in particular the individual features thereof, may be taken independently or in any combination. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination, unless such features are incompatible. The applicant reserves the right to change any originally filed claim or file any new claim accordingly, including the right to amend any originally filed claim to depend from and/or incorporate any feature of any other claim although not originally claimed in that manner.

BRIEF DESCRIPTION OF THE FIGURES

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying figures, in which;

Figure 1 shows a system diagram of an embodiment of a vehicle fuel system;

Figure 2 shows a flow diagram for operating the fuel system of Figure 1 in accordance with a habitual refuelling level scenario;

Figure 3 shows a flow diagram for the vehicle fuel system of Figure 1 according to a predicted future fuel usage scenario;

Figure 4 shows a flow diagram for the fuel system of Figure 1 operated in a scenario verifying the practicality of a refuelling instruction;

Figure 5 shows a system diagram of an embodiment of a navigation system; and

Figure 6 shows a flow diagram of the navigation system of Figure 5 in operation.

DETAILED DESCRIPTION

With reference to Figure 1, a vehicle 8 such as a car includes a fuel system 10. The fuel system includes a detection module 12, a monitoring module 14, a determination module 16 and a control module 26. The fuel system 10 also includes a display module 20.

The detection module 12 is in the form of a fuel level sensor. The fuel level sensor is provided within a fuel tank of the vehicle 8. The fuel level sensor, in one embodiment, is a potentiometer sensor. The fuel level sensor has a float arranged to follow the fuel level in order to modify the resistance of the potentiometer reading.

The detection module 12 is linked to the monitoring module 14. The monitoring module 14 monitors the fuel level sensor over time. In this way, the monitoring module 14 can monitor various fuel usage parameters. One such fuel usage parameter is the fuel usage rate. Another is the fuel level at which refuel occurs. The monitoring module is able to determine a fuel usage trend by monitoring the fuel usage parameter over a period of time. The monitoring module 14 includes an algorithm in order to create the fuel usage trend. The algorithm is based on a histogram model. The algorithm is described in more detail below.

The monitoring module 14 is communicatively linked to the control module 18. The control module 26 26 includes a processor and a memory unit. The memory unit includes a non-volatile memory component. The detection module 12, monitoring module 14, and the determination module 16 are stored as electronic data on the control module’s non-volatile memory component. The processor is arranged to execute each module during operation of the fuel system 10.

The control module 26 26 is arranged to provide a refuelling instruction to a vehicle user based on the fuel usage trend from the monitoring module. The refuelling instruction is sent to the display module 20.

The display module 20, in one embodiment is a flat screen panel monitor on the dashboard of the vehicle 8, although one skilled in the art would appreciate there are many methods for displaying this information. The display of the display module 20 is able to display text. The text may indicate that the refuelling instruction is to “refuel” or another refuelling instruction such as the “distance to empty” (i.e. the remaining distance that the vehicle can travel before the tank is empty).

The determination module 16 is communicatively linked to the monitoring module 14. The determination module 16 uses the fuel usage trend as an input to determine a future fuel usage prediction based on the fuel usage trend. The control module may use the future fuel usage prediction in order to provide the refuelling instruction as will be described in more detail below.

The control module 26 is communicatively linked to a mapping module 22. The mapping module 22 is arranged to generate various mapping inputs. Mapping inputs include a refuelling location, traffic density, and route information. The mapping module 22 includes a global positioning system (GPS). The mapping module uses the GPS coordinates of the vehicle's position relative to the route information and the refuelling locations. The traffic density data is stored as a statistical model whereby the traffic density along a road for a specific point in time is assigned a probability value.

Alternatively, the mapping module is communicatively linked to an external database via an electromagnetic medium such as 3G, 4G, Wi-Fi and other like. The mapping module can thus download and update mapping inputs such as the traffic density in real time. The control module 26 can use these mapping inputs to verify the practicality for providing such a refuelling instruction as will be described in more detail below.

The control module 26 is also communicatively linked to a driver identification module 24. The driver identification module is an external module to the fuel system. The driver identification module is located in the vehicle 8. The control module is thus arranged to receive driver identification information.

The driver identification module 24 has a receiver. The receiver is arranged to receive signals from a near frequency communication device such as an RFID chip held on a key fob or the key itself. Each driver has a designated key or key fob. The presence of the key or key fob allows for the specific driver to be identified. The control module 26 uses this driver identification information and feeds it back into the monitoring module 14 in order that the fuel usage trend may be specified for each driver of the vehicle.

Operation of the fuel system is best described with reference to different scenarios.

With reference to Figure 2, the fuel system may be used in a scenario where a refuelling instruction is provided in accordance with a habitual refuel level. In such a scenario, a fuel level is detected by the fuel level sensor. This is described at block 100 where the fuel level is the input. The identification of the driver is defined at block 102. The fuel level for the current driver is monitored over time at block 104. The level at which the identified driver refuels is determined. The fuel refill level is thus the fuel usage parameter. The most likely refuel level is monitored over time and a fuel usage trend is determined.

The fuel usage trend, as determined at block 106, is determined by the algorithm. The algorithm has two primary phases. The first phase is the learning phase. The second phase is the command phase.

During the learning phase, a count value, K, is provided which in this case is the number of refuels required for a reliable data set to be analysed. In this case K is 10 refuels. A counter counts the number of refuels, n. The refuelling instruction is not provided until n>K and a consistency value of the monitored data is above a predetermined consistency threshold.

The level of the fuel at each refuel, n, is recorded. When K>n, a curve of best fit is applied to the data. A peak value of the curve is obtained. For very consistent fuel levels at refuel the curve is accurate. However, some outlying values may be included for more inconsistent refuelling patterns. These outlying values are removed by applying a curve of best fit to the data.

The consistency value is determined by calculating the area under the curve between limits of plus or minus 1 litre from the peak value of the refuel level. If the consistency value is above a predetermined consistency threshold then the refuelling instruction is provided by the control module. As shown at block 108, the refuelling instruction “Refuel” will be sent to the display when the detected fuel level is below the peak value.

With reference to Figure 3, the fuel system may be operated in accordance with a future fuel usage scenario. The detection of the drivers’ identification and the fuel level are the same as with the previous scenario and so the corresponding blocks of the flow diagram of Figure 2 are labelled 100 greater.

The fuel usage monitored over time at block 210 works out and monitors the fuel usage rate which thus forms the fuel usage parameter. A fuel usage trend is determined at block 212 using an algorithm working in the same way as the algorithm described above. In this scenario, K is a number of days. 30 days (of vehicle usage) may be used in order to build up a reliable sample. The fuel usage at each minute of a sample day, n, is monitored.

Curves are constructed for each day, namely, a curve for Tuesday and a curve for Saturday (plus all other days). When the peak values are known and the consistency values are above a predetermined consistency threshold the refuelling instruction may be sent to the display. As per block 214, the current fuel level on a Monday is detected and the control module sends a refuelling instruction to the display if there is insufficient fuel for all or part of Tuesday's fuel usage. The refuelling instruction in this case may be "Refuel now for Tomorrow's journey" as shown at block 216.

With reference to Figure 4, another scenario of operating the fuel system is provided where any refuelling instructions are verified as being practical before being presented to the user. Blocks 200-214 from the previous scenario are consistent with the present scenario and as such, those blocks in Figure 4 are labelled 100 greater.

In addition to receiving the future usage prediction from the determination module, the control module receives one or more mapping inputs as per block 320. The mapping inputs include refuelling locations, fuel data, and traffic density information. The control module compares the recommendation for providing a refuelling instruction to the data provided by the mapping module to determine whether a refuel is practical or not. In this case, the traffic density en route to the local refuelling location is compared to the actual fuel level in the fuel tank. If the likely traffic density is very high then no refuelling instruction is provided since the net benefit in refuelling will be reduced by virtue of the likely fuel used in reaching the refuelling destination. The control module calculates the net benefit by calculating fuel usage in the likely traffic density compared to the traffic density during the following day's routine journey which includes a refuelling location. If much more fuel will be burnt taking a diversion especially for a refuel then the refuelling instruction is delayed until the following day. However if the traffic density is relatively low then the refuel is determined to be practical and a refuelling instruction is sent to the display module.

The mapping inputs are shown on Figure 4 between reference numeral 322 to 326. The determination as to whether or not the refuelling instruction will be practical is determined at block 328. The determination that no refuelling instruction should be provided us shown at block 330 and the decision to provide a refuelling instruction is shown a block 332.

Various other scenarios exist and other alterations may be made by the system architecture without departing from the scope of the present invention. For example, the classification of the fuel system as per the aforementioned description specifies that the mapping module and driver identification module are external modules to the fuel system. It may be possible to provide these mapping and driver identification modules as modules within the fuel system and stored as electronic data on the memory unit of the control module 26.

With reference to Figure 5, a vehicle 408 such as a car includes a navigation system 410. The navigation system 410 includes a mapping module 412, a learning module 414, a control module 418 and a display module 420.

The mapping module 412 includes route information such as roads together with refuelling locations and other points of interest. Information relating to specific points of interest such as the refuelling locations to the route information is also stored on the mapping module. The mapping module 412 also includes a global positioning system (GPS). The GPS is arranged to determine the vehicle's location. The mapping module 412 uses the vehicle location information to determine the vehicles current location relative to the route information and the refuelling locations. The mapping module 412 is communicatively linked to the learning module 414.

The learning module 414 is able to receive inputs from the mapping module and monitor the vehicle's location relative to the route information and refuelling locations over time. The learning module includes an algorithm. The operation of the algorithm is described in more detail below. In summary, the algorithm is able to determine a fuel usage trend with regards to the vehicle's usage and filter the refuelling locations such that a set of refuelling locations most frequented by the vehicle can be determined. The filtering is achieved by determining a frequency for each refuelling location. Any refuelling locations having a frequency value above a predetermined threshold are added to the fuel usage trend and classified as a refuelling location which the vehicle frequents.

The learning module 414 is also communicatively linked to a driver identification module 416. The driver identification module 416 is external to the navigation system 410. The learning module 414 is able to receive information from the driver identification module 416 as to the current driver of the vehicle. The driver identification module includes a receiver arranged to detect a near frequency communication device such as an RFID chip stored on a key fob or car key. In such an arrangement, each driver of the vehicle has a designated car key or key fob. The driver identification module 416 can thus detect the identification of the driver by the presence of a specific car key or key fob. The learning module 414 is thus able to determine a fuel usage trend of the most frequented refuelling locations associated with the identified driver of the vehicle.

The control module 418 includes a processor and a memory unit. The memory unit includes a non-volatile memory component. The information from the mapping module 412 and the driver identification module 416 together with the algorithm of the learning module 414 are stored as electronic data on the non-volatile memory component of the control module 418. The processor of the control module 418 executes the stored data in order to determine the fuel usage trend for each driver of the vehicle. The control module 418 is communicatively linked to a display module 420. The control module 418 is arranged to configure the display module 420 to display an electronic map (E-map) 422. The E-map shows the route information and refuelling locations together with the other points of interest if desired. After the fuel usage trend has been established for each driver, the refuelling locations most frequented by the identified driver of the vehicle are displayed on the E-map 422 alone i.e. without any other (non-frequented) refuelling locations.

The control module 418 is communicatively linked to a fuel parameter database 424. The database 424 is external to the vehicle on a remote server. The control module 418 has a transceiver in order to communicate with the fuel parameter database 424. The transceiver is arranged to communicate with the fuel parameter database by an electromagnetic medium 426. The electromagnetic medium 426 is, but not limited to, 3G or 4G. In addition, the electromagnetic medium 426 may also be Wi-Fi based.

The display module 420 has a display and more specifically a flat screen colour display. The display is built into the vehicle dashboard. The display module 420 may also have a touch screen function allowing a user to input data such as preferred destination. The E-map 422 is arranged to provide directions to the driver and also a plan view of the route.

With reference to figure 6, the navigation system operates by first obtaining refuelling locations together with any other route information as shown at block 500. At block 502 the relative position of the vehicle is determined relative to the refuelling locations. At block 504 the driver ID of the driver currently driving the vehicle is determined by the driver identification module.

The most frequently visited refuelling locations for the driver are determined at block 506. As described above, the algorithm of the learning module 414 determines the most frequently visited refuelling locations. The algorithm works in two principle phases. The first phase is a learning phase and the second phase is a control phase. The learning phase initiates by starting a cycle count, n, where each count corresponds to a refuel of the vehicle. The control phase starts when the count, n, is greater than a count threshold, K, such as 10 refuels. The location of the vehicle is stored by the learning module at each count, n. The number of times the vehicle has refuelled at a location is assigned a value, f. When the ratio of f/K is greater than or equal to a predetermined fuel usage trend value, such as 0.3, the respective refuelling location is classified as a frequented refuelling location. For a ratio of f/K less than the predetermined fuel usage trend value, in this case 0.3, the respective refuelling location is classified as an infrequent location. The algorithm continues to update over time such that factors such as a change in employment or residential location of the driver of the vehicle are taken into account.

At block 508, the navigation system 410 requests to download a set of fuel parameters for the selected list of frequented refuelling locations for the current driver of the vehicle. The navigation system 410 thus downloads the selected fuel parameters over the electromagnetic medium 426 from the fuel parameters database 424. Since only a selective list of fuel parameters are downloaded, as opposed to a blanket download of all fuel parameters for every refuelling location, the memory usage of the control module 418, processing of the stored fuel parameters, and data usage in downloading the fuel parameters are all improved.

At block 512 the navigation system 410 displays the selected fuel parameters on the E-map 422 of the display module together with the refuelling locations corresponding to each set of fuel parameters downloaded. The fuel parameters are matched to each refuelling location and presented together on the E-map 422.

Various modifications and alternatives to the aforementioned systems or envisage which do not depart from the scope of the present invention.

CLAIMS

1. A fuel system for a vehicle, comprising;

   a detection module arranged to detect a fuel usage parameter;

   a monitoring module arranged to monitor the fuel usage parameter over time to determine a fuel usage trend; and

   a control module arranged to provide a refuelling instruction to a vehicle user based on the fuel usage trend.

2. The vehicle fuel system of claim 1 wherein the detection module comprises a fuel level sensor.

3. The vehicle fuel system of claim 1 or 2 wherein the fuel usage parameter includes a fuel level at which a user refuels.

4. The vehicle fuel system of claim 1 or 2 wherein the fuel usage parameter includes fuel usage rate.

5. The vehicle fuel system of any preceding claim comprising a determination module for determining a future fuel usage prediction based on the fuel usage trend.

6. The vehicle fuel system of claim 5 wherein the refuelling instruction is based on the future fuel usage prediction.

7. The vehicle fuel system of any preceding claim wherein the control module is arranged to communicate with a mapping module for providing a mapping input to the control module, the control system arranged to verify the refuelling instruction based on a mapping input.

8. The vehicle fuel system of claim 7 wherein the mapping input includes refuelling location data.

9. The vehicle fuel system of claim 8 wherein the mapping input includes traffic density data.

10. The vehicle fuel system of any preceding claim wherein the control module is arranged to receive driver identification information from a driver identification module and determine a fuel usage trend specific to each driver.

11. A vehicle comprising the vehicle fuel system according to any preceding claim.

12. A method of automating a refuelling instruction, comprising the steps of;

    detecting a fuel usage parameter;

    monitoring the fuel usage parameter over time;

    determining a fuel usage trend based on the fuel usage parameter over time; and

    providing a refuelling instruction based on the fuel usage trend.

13. The method of claim 12 wherein the step of detecting the fuel usage parameter comprises the step of detecting a fuel level at which the vehicle user refuels.

14. The method of claim 12 wherein the step of detecting the fuel usage parameter comprises the step of detecting a fuel usage rate.

15. The method of claim 14 comprising the step of predicting the future fuel usage and providing the refuelling instruction based on the future fuel usage prediction.

16. The method of any of claims 12 to 15 comprising the steps of obtaining a mapping input and verifying the refuelling instruction based on the mapping input.

17. The method of claim 16 wherein obtaining the mapping input comprises obtaining refuelling location data.

18. The method of claim 17 wherein obtaining the mapping instruction comprises obtaining traffic density data.

19. A vehicle fuel system as substantially described herein with reference to the accompanying figures.

20. A method of automating a refuelling instruction as substantially described herein with reference to the accompanying figures.

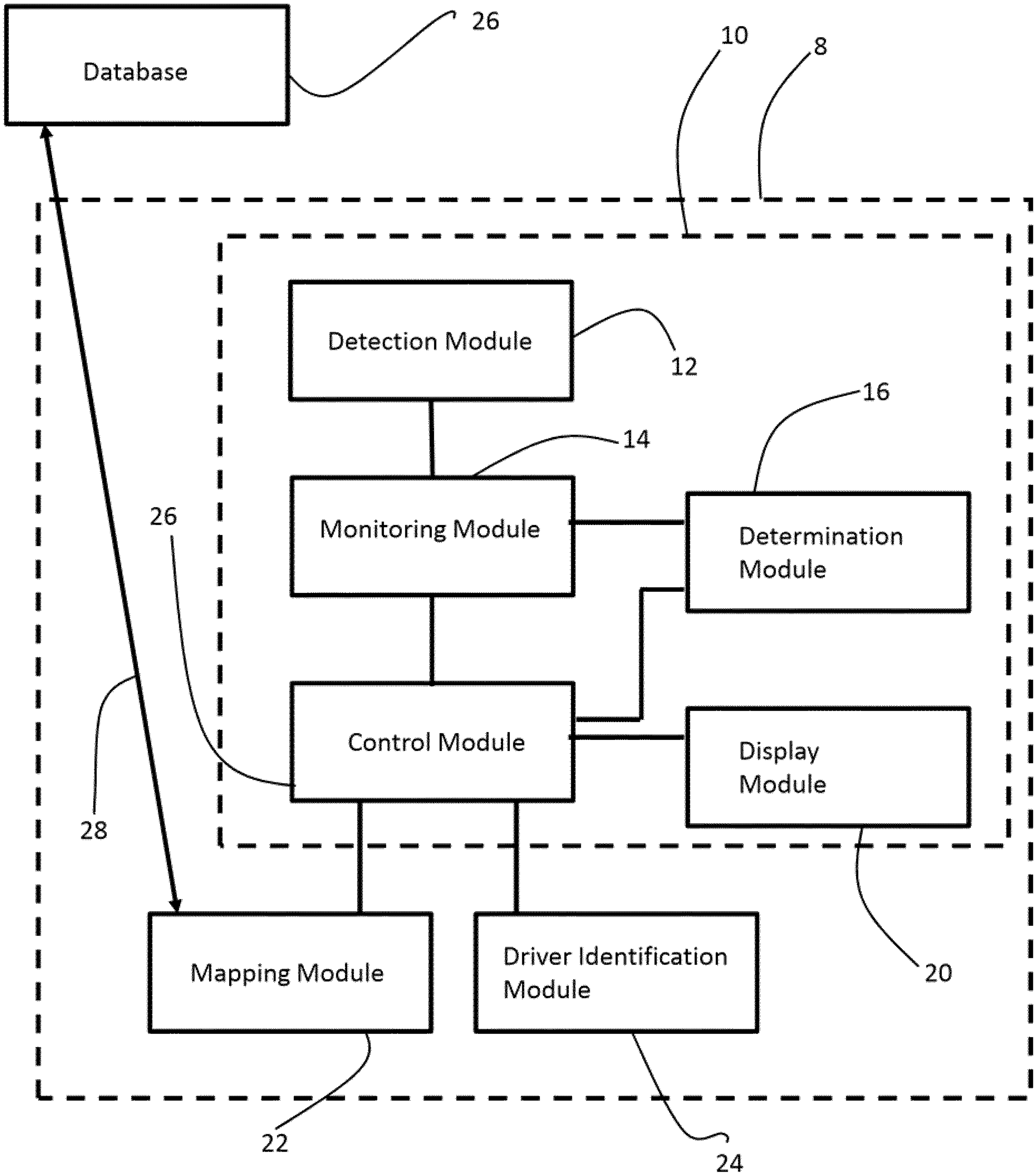
Database
26
10
8
Detection Module
12
16
14
Monitoring Module
Determination Module
26
Control Module
Display Module
28
Mapping Module
Driver Identification Module
20
22
24

Figure 1

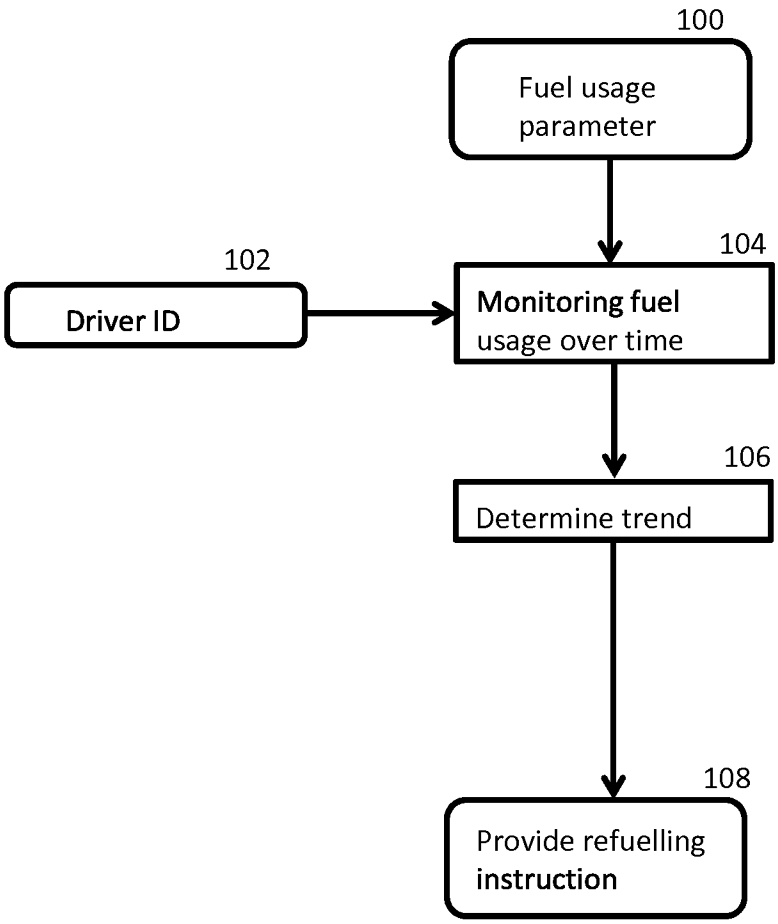
100
Fuel usage parameter
102
Driver ID
104
Monitoring fuel usage over time
106
Determine trend
108
Provide refuelling instruction

Figure 2

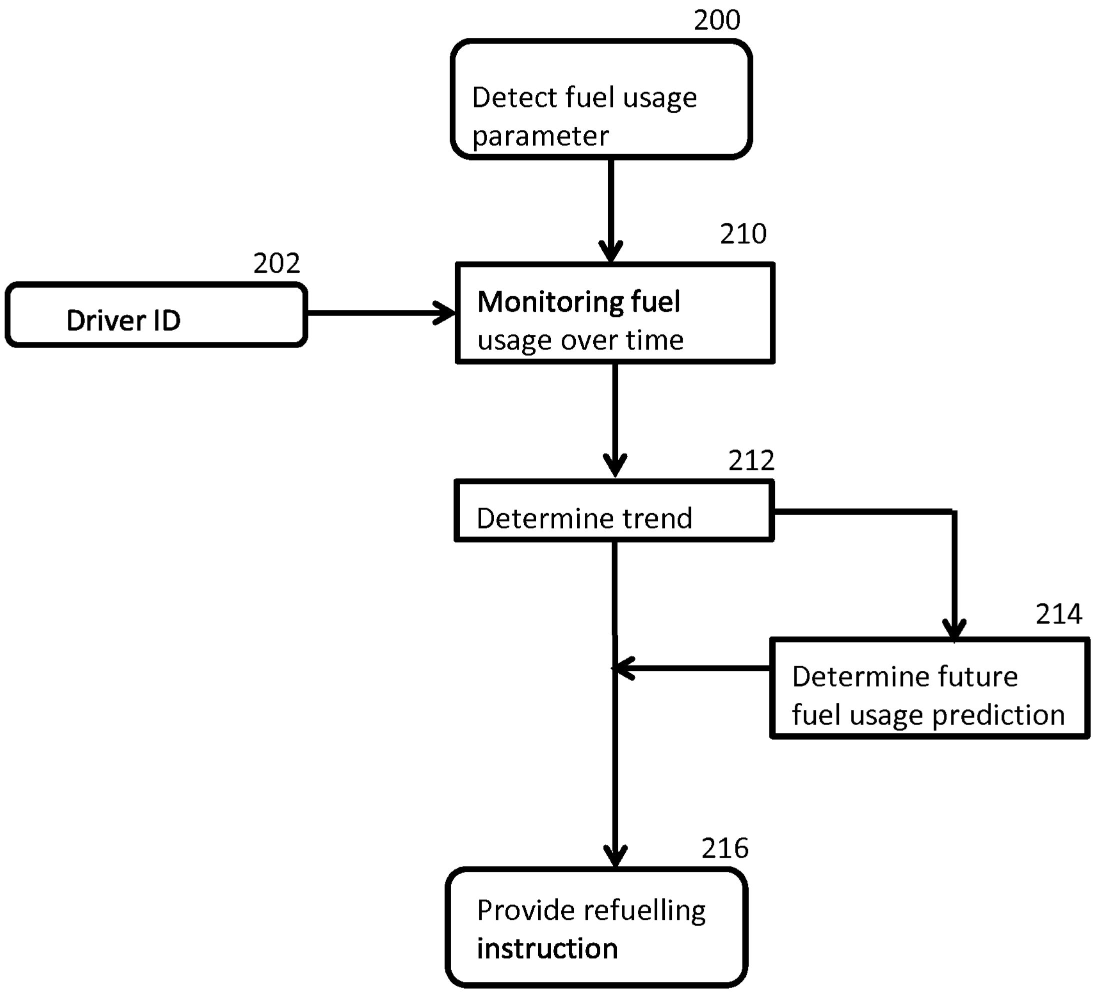
200
Detect fuel usage parameter
210
202
Driver ID
Monitoring fuel usage over time
212
Determine trend
214
Determine future fuel usage prediction
216
Provide refuelling instruction

Figure 3

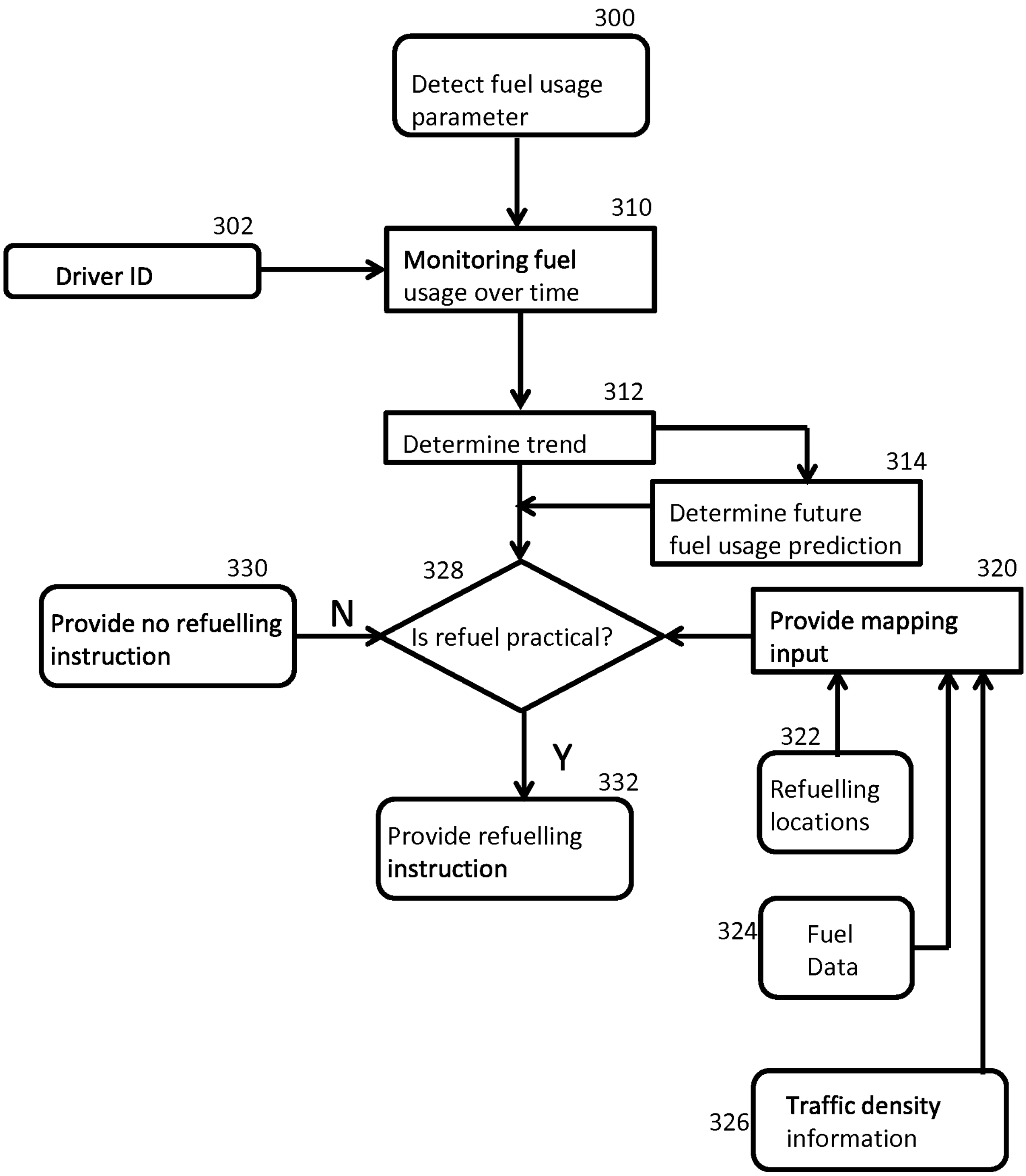
300
Detect fuel usage parameter
302
Driver ID
310
Monitoring fuel usage over time
312
Determine trend
314
Determine future fuel usage prediction
330
Provide no refuelling instruction
N
328
Is refuel practical?
320
Provide mapping input
Y
332
Provide refuelling instruction
322
Refuelling locations
324
Fuel Data
326
Traffic density information

Figure 4

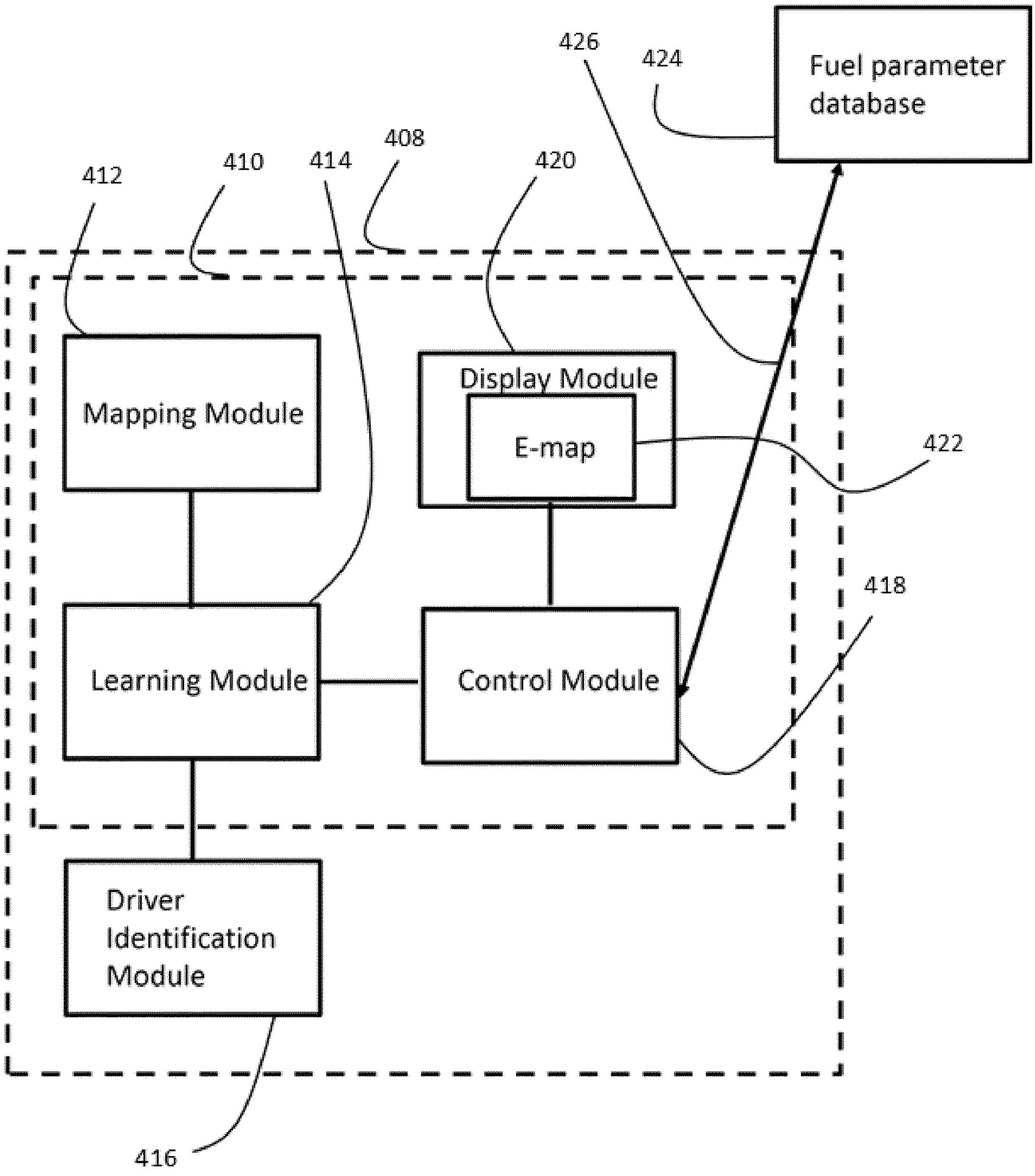
Fuel parameter database
Mapping Module
Display Module
E-map
Learning Module
Control Module
Driver Identification Module
408
410
412
414
416
418
420
422
424
426

Figure 5

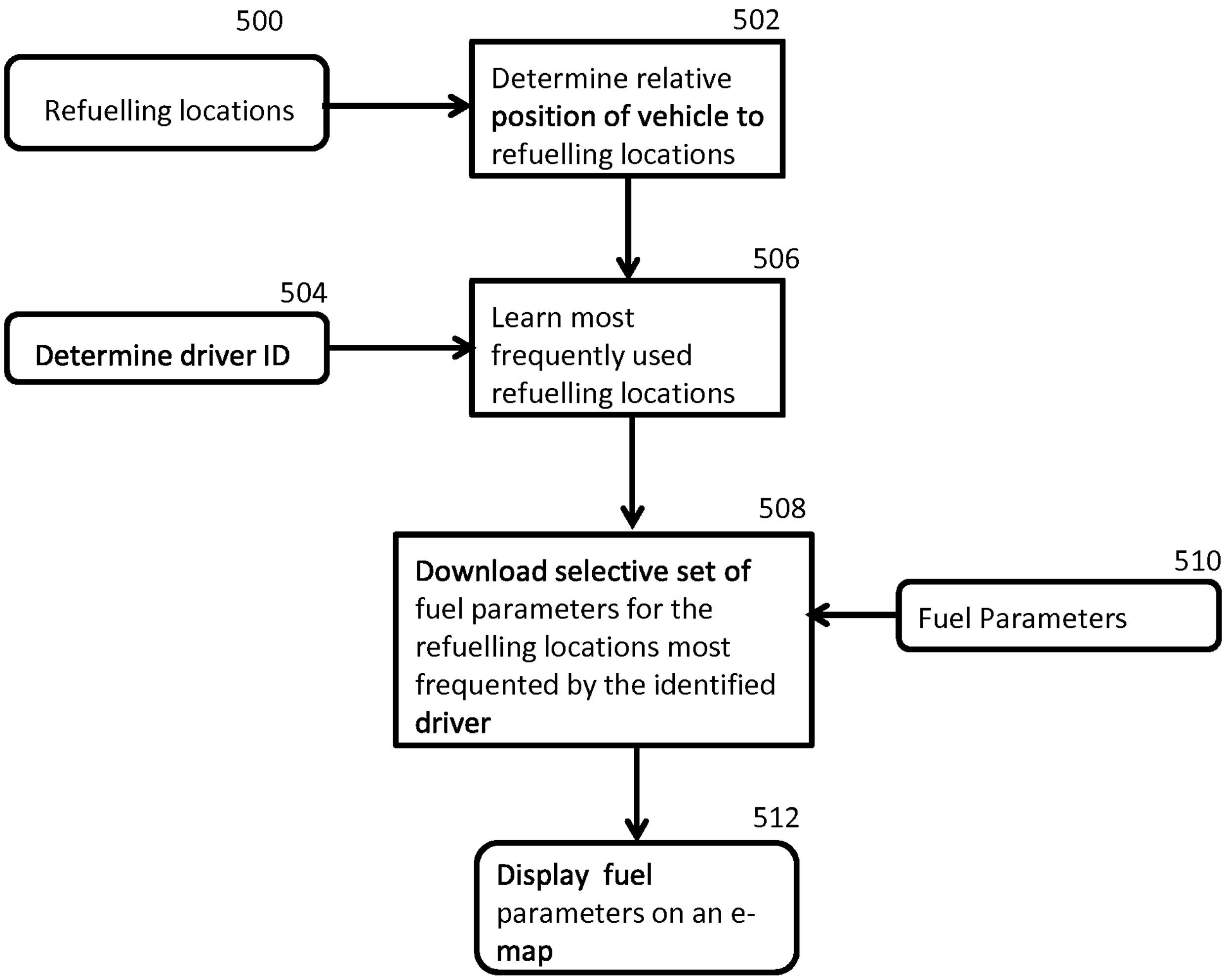
500
Refuelling locations
502
Determine relative position of vehicle to refuelling locations
504
Determine driver ID
506
Learn most frequently used refuelling locations
508
Download selective set of fuel parameters for the refuelling locations most frequented by the identified driver
510
Fuel Parameters
512
Display fuel parameters on an e-map

Figure 6