



(11) **EP 3 147 882 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
29.03.2017 Bulletin 2017/13

(51) Int Cl.:
G08G 1/01 (2006.01) G08G 1/0967 (2006.01)

(21) Application number: **15186413.9**

(22) Date of filing: **23.09.2015**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA

(72) Inventors:
• **Malinowski, Pawel Michal**
30-127 Krakow (PL)
• **Suchy, Jozef Szczepan**
31-881 Krakow (PL)

(74) Representative: **Kancelaria Eupatent.pl Sp. z o.o**
Ul. Kilinskiego 185
90-348 Lodz (PL)

(30) Priority: **22.09.2015 PL 41404215**

(71) Applicant: **Akademia Gorniczo-Hutnicza im. Stanislaw**
Staszica w Krakowie
30-059 Krakow (PL)

(54) **A SYSTEM AND A METHOD FOR AN INTELLIGENT TRANSPORTATION SYSTEM**

(57) A method for an intelligent transportation system, the method comprising the steps of: reading (201) a vehicle's geolocation and determining a direction of its movement; determining (202) the closest traffic light based on the vehicles position and direction of movement; determining (203) a distance between the vehicle and the closest traffic light; determining (204) the closest traffic light's phase and its remaining time; determining (205) a number of vehicles in the group of vehicles between the vehicle and the closest traffic light; and based on the aforementioned data, calculating (206) an optimum vehicle speed and transmitting (207) the result of this calculation to the vehicle.

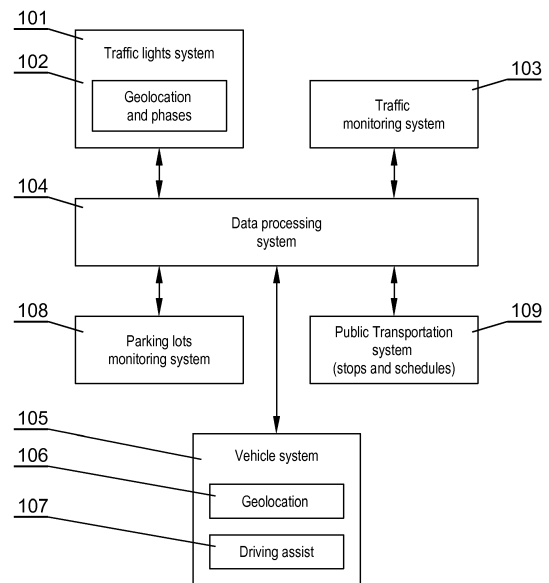


Fig. 1

EP 3 147 882 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a system and a method for an intelligent transportation system (ITS). In particular, the present invention relates to monitoring of traffic conditions and recommending optimal speeds for different vehicles present in proximity to an intersection where traffic lights have been installed. The system is applicable in a so called Smart City concept implementation.

BACKGROUND OF THE INVENTION

[0002] Prior art defines ITSs (Intelligent Transportation Systems) as systems, in which information and communication technologies are applied in the field of road transport, including transportation system infrastructure, appropriately equipped vehicles and trained users, and in traffic and mobility management, as well as for interfaces with other modes of transport.

[0003] ITSs are implemented by using different technologies to monitor traffic, such as car navigation, traffic signal control systems, variable message road signs, automatic number plate recognition or speed cameras. Frequently, ITS implementations monitor traffic in real-time and use data obtained from other sources, such as parking guidance and information systems, weather information and the like. In more sophisticated ITSs, there may be employed predictive techniques that are aimed at modeling and comparison with historical traffic data. This arrangement typically requires devices installed in vehicles, as well as a distributed or a centralized ITS server system. The server processes much more data than typical client devices installed in cars. ITS may employ three kinds of communication, which may be combined together: (a) vehicle-vehicle, (b) vehicle-infrastructure and (c) infrastructure-vehicle.

[0004] A US patent US5519390 discloses a traffic light timer, which provides a visible and accurate warning that a traffic light signal is about to change. The time remaining before the change is displayed in numeric form on a display and visibly counts down the seconds remaining. The display can be alphanumeric or graphical, allowing for the display of free form icons. Such timer may allow the driver to adapt the speed of travel to drive optimally, i.e. to slow down when the driver assumes that the light will soon change to red, or to speed up when the driver assumes that there is sufficient time to cross the road at green light. The drawback of the system is that it requires the driver to make own assessments and that it is effective only within the range of the eyesight of the driver.

[0005] A US patent application US20130110371 discloses a driving assisting apparatus that assists in driving a vehicle and includes: a vehicle speed sensor that detects a vehicle speed of the vehicle; a control unit that determines a recommended traveling state based on a

current vehicle speed detected by the vehicle speed sensor and at least one of an accelerated vehicle speed when the vehicle accelerates from the current vehicle speed at an allowable acceleration and a decelerated vehicle speed when the vehicle decelerates from the current vehicle speed at an allowable deceleration; and an assisting unit that assists in driving the vehicle based on the recommended traveling state determined by the control unit. By determining whether to pass through, or stop at, a traffic light location, a driving assisting apparatus can assist a vehicle to pass through a traffic light location if the color of the traffic light is green when the vehicle arrives at the traffic light location by accelerating from the current vehicle speed at a predetermined acceleration or when the vehicle arrives at the traffic light location by decelerating from the current speed at a predetermined deceleration. The information required for calculating the target vehicle speed range includes the infrastructure information including the lighting cycle and the traffic light change time of the traffic light, through which the vehicle will pass, the information on the current position of the vehicle required for calculating the distance between the vehicle and the traffic light, and the map information including the position information on the traffic light.

[0006] Since traffic is an always changing environment, it would be advantageous to implement an ITS taking into account real time conditions in assisting in driving a vehicle. This would further enhance ITS capabilities and take into account the precise traffic conditions.

[0007] Therefore, the aim of the development of the present invention is an improved method and apparatus for a system and method for an intelligent transportation system.

SUMMARY

[0008] The object of the invention is a method for an intelligent transportation system, the method comprising the steps of: reading a vehicle's geolocation and determining a direction of its movement; determining the closest traffic light based on the vehicle's position and direction of movement; determining a distance between the vehicle and the closest traffic light; determining the closest traffic light's phase and its remaining time; determining a number of vehicles in the group of vehicles between the vehicle and the closest traffic light; and based on the aforementioned data, calculating an optimum vehicle speed and transmitting the result of this calculation to the vehicle.

[0009] Preferably, for each vehicle of the group of vehicles a distance traveled by each of these vehicles in a given amount of time is taken into account in the calculating step.

[0010] Preferably, determining vehicles' count between the vehicle and the closest traffic light further comprises determining a distance traveled by each of these vehicles in a given amount of time.

[0011] Preferably, the step of calculating an optimum

vehicle speed takes into account statistical data related to leaving this particular intersection by vehicles.

[0012] Preferably, the reading step further comprises a step of reading a vehicle's route.

[0013] Preferably, the step of reading is executed for a plurality of vehicles and based on the received route of each vehicle, calculating traffic conditions in the future.

[0014] Preferably, selectively suggesting alternative routes for selected vehicles based on the predicted traffic conditions in the near future.

[0015] The invention is also related to a computer program comprising program code means for performing all the steps of the computer-implemented method as defined above when said program is run on a computer, as well as to a computer readable medium storing computer-executable instructions performing all the steps of the computer-implemented method as defined above when executed on a computer.

[0016] Another object of the invention is a system for an intelligent transportation system, the system comprising: a traffic lights system providing data regarding geolocation and phases of traffic lights; a traffic monitoring system configured to determine how many vehicles there are between a given vehicle and a given traffic light; a data processing server communicatively connected with client systems present in vehicles each client system comprising a geolocation module configured to provide information on vehicle's location; and wherein the data processing server is configured to execute all steps of the method as defined above.

BRIEF DESCRIPTION OF DRAWINGS

[0017] These and other objects of the invention presented herein, are accomplished by providing a system and method for an intelligent transportation system. Further details and features of the present invention, its nature and various advantages will become more apparent from the following detailed description of the preferred embodiments shown in a drawing, in which:

- Fig. 1 presents a diagram of the system according to the present invention;
- Fig. 2 presents a diagram of the method according to the present invention;
- Fig. 3 presents an example of a user interface.

NOTATION AND NOMENCLATURE

[0018] Some portions of the detailed description which follows are presented in terms of data processing procedures, steps or other symbolic representations of operations on data bits that can be performed on computer memory. Therefore, a computer executes such logical steps thus requiring physical manipulations of physical quantities.

[0019] Usually these quantities take the form of electrical or magnetic signals capable of being stored, trans-

ferred, combined, compared, and otherwise manipulated in a computer system. For reasons of common usage, these signals are referred to as bits, packets, messages, values, elements, symbols, characters, terms, numbers, or the like.

[0020] Additionally, all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Terms such as "processing" or "creating" or "transferring" or "executing" or "determining" or "detecting" or "obtaining" or "selecting" or "calculating" or "generating" or the like, refer to the action and processes of a computer system that manipulates and transforms data represented as physical (electronic) quantities within the computer's registers and memories into other data similarly represented as physical quantities within the memories or registers or other such information storage.

[0021] A computer-readable (storage) medium, such as referred to herein, typically may be non-transitory and/or comprise a non-transitory device. In this context, a non-transitory storage medium may include a device that may be tangible, meaning that the device has a concrete physical form, although the device may change its physical state. Thus, for example, non-transitory refers to a device remaining tangible despite a change in state.

[0022] As utilized herein, the term "example" means serving as a non-limiting example, instance, or illustration. As utilized herein, the terms "for example" and "e.g." introduce a list of one or more non-limiting examples, instances, or illustrations.

DETAILED DESCRIPTION

[0023] Fig. 1 presents a diagram of the system according to the present invention. The system comprises a traffic lights system 101, preferably synchronized using a GPS time. The traffic lights system 101 provides data regarding geolocation and phases of traffic lights. A corresponding database 102 stores, per each traffic light, a geolocation, current phase (green, yellow, red, pulsing yellow) as well as remaining duration of the current phase and programmed subsequent phases. The phases may be programmed by the respective ITS system depending on a traffic present on lane(s) to which the respective traffic light is assigned.

[0024] An exemplary record of the database 102, describing a particular traffic light, may have the following contents:

- Geolocation = 52°28'44.2"N 13°21'15.0"E
- Lane = middle lane
- Current phase = red; 15s
- Subsequent phases = Loop: {red(60);yellow(4);green(25);yellow(4)}

[0025] This means that this traffic light at the particular geolocation is currently in the red phase and will remain in the red phase for the next 15 seconds. The record

further specifies that the traffic light operates in a loop wherein a red phase lasts 60s, the subsequent yellow phase lasts 4s, while a subsequent green phase lasts 25s and is followed by a yellow phase of 4s.

[0026] The system further comprises a traffic monitoring subsystem 103 configured to determine how many vehicles there are between a given vehicle and a given traffic light (in general, an intersection). This may be achieved by analyzing a geolocation signal received from each of passing vehicles or the data may be obtained via other detection means, such as CCTV cameras combined with image processing and object detection or Inductive loop detection or Bluetooth detection. Alternatively, more than one method of vehicles detection may be employed in order to obtain more accurate results.

[0027] Thus, the traffic monitoring system 103 is not only aware of how many vehicles there are in a given area, but the system is also aware which vehicles these are and has a capability of selectively communicating with these vehicles. Visual information from the traffic monitoring system 103 may aid a traffic management centre to take actions in real time.

[0028] Both the traffic lights system 101 and the traffic monitoring system 103 are connected to a data processing server 104, which also communicates with client systems present in vehicles 105. Such a client system comprises a geolocation module 106 providing constant information on vehicle's location (eg. GPS) as well as a driving assist system 107 providing information to a driver. The information provided by the driving assist system 107 is received from the server 104 and preferably presented on a display screen.

[0029] The client system may have a form of a navigation system installed on board of a vehicle, or a portable device, such as a tablet or a smartphone. The client system 105 comprises a data interface for communicating with the data interface of the server via a communication link. The communication may be effected via a dedicated communication channel, or via standard communication channels, such as the Internet. Each client device may also be configured to operate as a video recorder of what is happening in front of a vehicle in which the client device is installed. Information about the registered event, along with its detailed localization, can be transferred to another entity, for example to police information system (for example, to the nearest police station) by one-click action.

[0030] Each vehicle's client system sends geolocation data to the data processing server 104, which after traffic analysis determines traffic between the vehicles location and the next intersection (traffic lights).

[0031] Common traffic factors include vehicle presence as such, traffic flow rate (per unit of time), traffic occupancy and density, traffic speed, vehicle headway, and traffic queue length.

[0032] This information is used to optimize speed recommendation for the vehicle.

[0033] Having access to geolocation data from the ve-

hicles, the data processing server 104 may create a map of traffic with respect to existing map (for example a city map). This allows for a constant traffic monitoring. Each vehicle may have an associated route it follows, while statistical data per vehicle and/or per traffic state at a given time and date may be used to predict traffic in the future e.g. in 5, 10, 15 minutes.

[0034] The traffic map also allows the data processing server 104 to determine an optimized route for each given vehicle, based on current traffic conditions as well as predicted traffic conditions.

[0035] The system may be extended with an addition of a parking lots monitoring system 108 providing a database of free parking spaces comprising geolocation of the parking spaces (free and/or occupied). Each parking space may be automatically monitored by a suitable sensor that would update its information in the database once it becomes free or occupied. The parking lots monitoring system 108 sends to the server 104 information about free parking spaces. Next, the server 104 analyzes the current position of the vehicle and determines the path to the nearest free parking space, which has simultaneously its status changed to "reserved" - therefore, the system 104 will not propose this parking space to other vehicles.

[0036] The system may also comprise a public transportation system database 109 providing information on stops and schedules of public transport. This may be beneficial in case of heavy traffic, a user may be recommended a route including public transport instead of a car. Owing to the aforementioned traffic map, a user planning a route may be advised not to take a car in certain conditions of traffic. The public transportation system 109 comprises a database of information about paths of public transportation vehicles, their stops and locations, communication nodes wherein a passenger may change transport means, detailed schedule of arrivals and departures. The information is sent to the server 104, which may analyze the time of travel by car and by the public transportation vehicles to the destination, taking into account current traffic and the predicted time of transport by public transportation - and suggest the user with the fastest transport means.

[0037] Fig. 2 presents a diagram of the method according to the present invention. The method starts at step 201 to read vehicle's geolocation and determine direction of its movement. This information is received from a client device installed in a particular vehicle. The direction of movement may be determined from vehicle's navigation system or determined based on a change in geolocation of the vehicle over a period of time. Subsequently, at step 202, the data processing system 104 determines the closest traffic light, with respect to the vehicle, based on the data from the traffic lights system 101. In order to determine that, a vehicles position and direction of movement is taken into account.

[0038] Next, at step 203, the server 104 determines a distance between the vehicle and the closest traffic light.

This may take into account a map of roads available to the data processing server 104 and a suitable distance calculation module based on coordinates of two points of the respective map.

[0039] Subsequently, at step 204, the data processing server 104 determines the closest traffic light's phase and its remaining time in order to lastly determine 205 the number of vehicles between the vehicle and the closest traffic light (while traveling on a selected route). In a more advanced version of the system, not only the number of vehicles is taken into account but also a distance traveled by each of these vehicles in a given amount of time. The monitored amount of time may be different depending on distance between the vehicle and the closest traffic light.

[0040] Based on the aforementioned data, the data processing server 104 calculates 206 an optimum vehicle speed and transmits the result of this calculation to the vehicle at step 207. In order to maintain reliable service, transmission to the client device of a vehicle, may also comprise a time stamp defining the time, at which it has been generated. The client device may then determine a time lag between the time at which the information was generated at the server 104 and at which was actually processed by the client 105. This may not be required in an embodiment, when the server and the clients are synchronized for example with a GPS time.

[0041] It is clear that such calculation must take place periodically, the more frequent the execution of the process, the more precise the recommendation of the optimum speed will be.

[0042] Fig. 3 presents an example of a user interface wherein item 301 indicates traffic light phase as well as a recommended speed for the vehicle depending on a selected road lane. Item 302 presents another example showing a recommended vehicle speed as well as traffic light phase and timeout of the respective traffic light phases.

[0043] Two implementation examples of the present invention will be presented below.

[0044] The first example is a case taking into account current traffic based on geolocation of other vehicles.

[0045] Each vehicle comprises a client system 105 running an appropriate software and having access to its geolocation (typically a smartphone). The device also communicates with a server (typically via the Internet).

[0046] The server 104 comprises a database of geolocations of traffic lights and information on traffic lights phases for each road lane.

[0047] A vehicle joining traffic, cyclically transmits its geolocation (A) to the server 104. Simultaneously, the server 104 receives geolocations of other vehicles and associates these geolocations with a traffic map. Next, based on geolocation change in time, there is calculated current speed. The system analyzes geolocation of vehicle A and its distance from traffic lights B, the traffic light phases, taking into account speed of other vehicles on a given section of the road as well as statistical data

related to leaving this particular intersection by vehicles.

[0048] Based on this analysis the server 104 calculates optimum speed, not higher than a maximum allowed speed, and transmits a result of the calculation to the vehicle A.

$$V = dx/dt$$

$$dx = B - A$$

wherein:

A is the current geolocation of a vehicle;

B is the geolocation of the closest traffic lights.

[0049] The aforementioned is executed cyclically, for example every few seconds. This will allow to keep the amount of transmitted data at reasonable and acceptable levels. The device of the vehicle may also receive data on traffic lights and phase so that it displays the closest traffic lights states e.g. colors and times of phases. This also improves safety as it happens that a vehicle stopped at a traffic light is so positioned that a driver does not see the lights or it is difficult for the driver to look at the lights.

[0050] The second implementation example of the present invention includes traffic prediction in near future. Each client system present in vehicles 105 comprises a programmed route the driver will follow. This route, associated with the vehicle, is transmitted to the server 104. All other data transmitted to the server 104 in case of example number one are also transmitted to the server 104 in the example number two.

[0051] The server 104 calculates an average speed for each vehicle on a given road section, based on geolocation of each vehicle, current speed of each vehicle, current traffic on the road section, transmitted vehicles' routes.

[0052] The server also may calculate a time of arrival at a destination based on calculated speed, distance, traffic lights phases as well as traffic flow rates at different intersections.

[0053] Further, based on the received route of each vehicle and current traffic, the server 104 may calculate traffic conditions in the near future e.g. 5, 10 or 15 minutes. Having access to this information, routes of vehicles may selectively be recalculated and alternative routes may be suggested for selected vehicles based on the predicted traffic conditions in the near future. For example, when traffic flow close to zero is detected at an intersection, while vehicles are standing in front of it, it may be an indicator that there is an accident and the intersection is blocked. In such cases alternative routes may be quickly advised.

[0054] The system according to the present invention,

may be implemented not only in cities but also on highways, suburban roads and other roads between cities. This in turn would allow for implementing a country-wide ITS.

[0055] The present invention optimizes traffic and provides useful information to drivers who may adjust their driving style and thereby save fuel. Therefore, the invention provides a useful, concrete and tangible result. Further, the present invention has been implemented as an ITS client-server system, which processes traffic information in order to recommend driving behavior. Thus, the machine or transformation test is fulfilled and that the idea is not abstract.

[0056] At least parts of the methods according to the invention may be computer implemented. Accordingly, the present invention may take the form of an entirely hardware embodiment, an entirely software embodiment (including firmware, resident software, micro-code, etc.) or an embodiment combining software and hardware aspects that may all generally be referred to herein as a "circuit", "module" or "system".

[0057] Furthermore, the present invention may take the form of a computer program product embodied in any tangible medium of expression having computer usable program code embodied in the medium.

[0058] It can be easily recognized, by one skilled in the art, that the aforementioned method for an intelligent transportation system may be fully or partially performed and/or controlled by one or more computer programs. Such computer programs are typically executed by utilizing the computing resources in a computing device. Applications are stored on a non-transitory medium. An example of a non-transitory medium is a non-volatile memory, for example a flash memory while an example of a volatile memory is RAM. The computer instructions are executed by a processor. These memories are exemplary recording media for storing computer programs comprising computer-executable instructions performing all the steps of the computer-implemented method according to the technical concept presented herein.

[0059] While the invention presented herein has been depicted, described, and has been defined with reference to particular preferred embodiments, such references and examples of implementation in the foregoing specification do not imply any limitation on the invention. It will, however, be evident that various modifications and changes may be made thereto without departing from the broader scope of the technical concept. The presented preferred embodiments are exemplary only, and are not exhaustive of the scope of the technical concept presented herein.

[0060] Accordingly, the scope of protection is not limited to the preferred embodiments described in the specification, but is only limited by the claims that follow.

Claims

1. A method for an intelligent transportation system, the method being **characterized in that** it comprises the steps of:
 - reading (201) a vehicle's geolocation and determining a direction of its movement;
 - determining (202) the closest traffic light based on the vehicles position and direction of movement;
 - determining (203) a distance between the vehicle and the closest traffic light;
 - determining (204) the closest traffic light's phase and its remaining time;
 - determining (205) a number of vehicles in the group of vehicles between the vehicle and the closest traffic light; and
 - based on the aforementioned data, calculating (206) an optimum vehicle speed and transmitting (207) the result of this calculation to the vehicle.
2. The method according to claim 1 wherein for each vehicle of the group of vehicles a distance traveled by each of these vehicles in a given amount of time is taken into account in the calculating step.
3. The method according to claim 1 **characterized in that** determining (205) vehicles' count between the vehicle and the closest traffic light further comprises determining a distance traveled by each of these vehicles in a given amount of time.
4. The method according to claim 1 being **characterized in that** the step of calculating (206) an optimum vehicle speed takes into account statistical data related to leaving this particular intersection by vehicles.
5. The method according to claim 1 being **characterized in that** the reading step (201) further comprises a step of reading a vehicle's route.
6. The method according to claim 5 being **characterized in that** step of reading is executed for a plurality of vehicles and based on the received route of each vehicle, calculating traffic conditions in the future.
7. The method according to claim 6 being **characterized in** selectively suggesting alternative routes for selected vehicles based on the predicted traffic conditions in the near future.
8. A computer program comprising program code means for performing all the steps of the computer-implemented method according to claim 1 when said program is run on a computer.

9. A computer readable medium storing computer-executable instructions performing all the steps of the computer-implemented method according to claim 1 when executed on a computer.

5

10. A system for an intelligent transportation system, the system being **characterized in that** it comprises:

- a traffic lights system (101) providing data regarding geolocation and phases of traffic lights; 10
- a traffic monitoring system (103) configured to determine how many vehicles there are between a given vehicle and a given traffic light;
- a data processing server (104) communicatively connected with client systems present in vehicles (105) each client system comprising a geolocation module (106) configured to provide information on vehicle's location; and 15
- wherein the data processing server (104) is configured to execute all steps of the method according to claim 1. 20

25

30

35

40

45

50

55

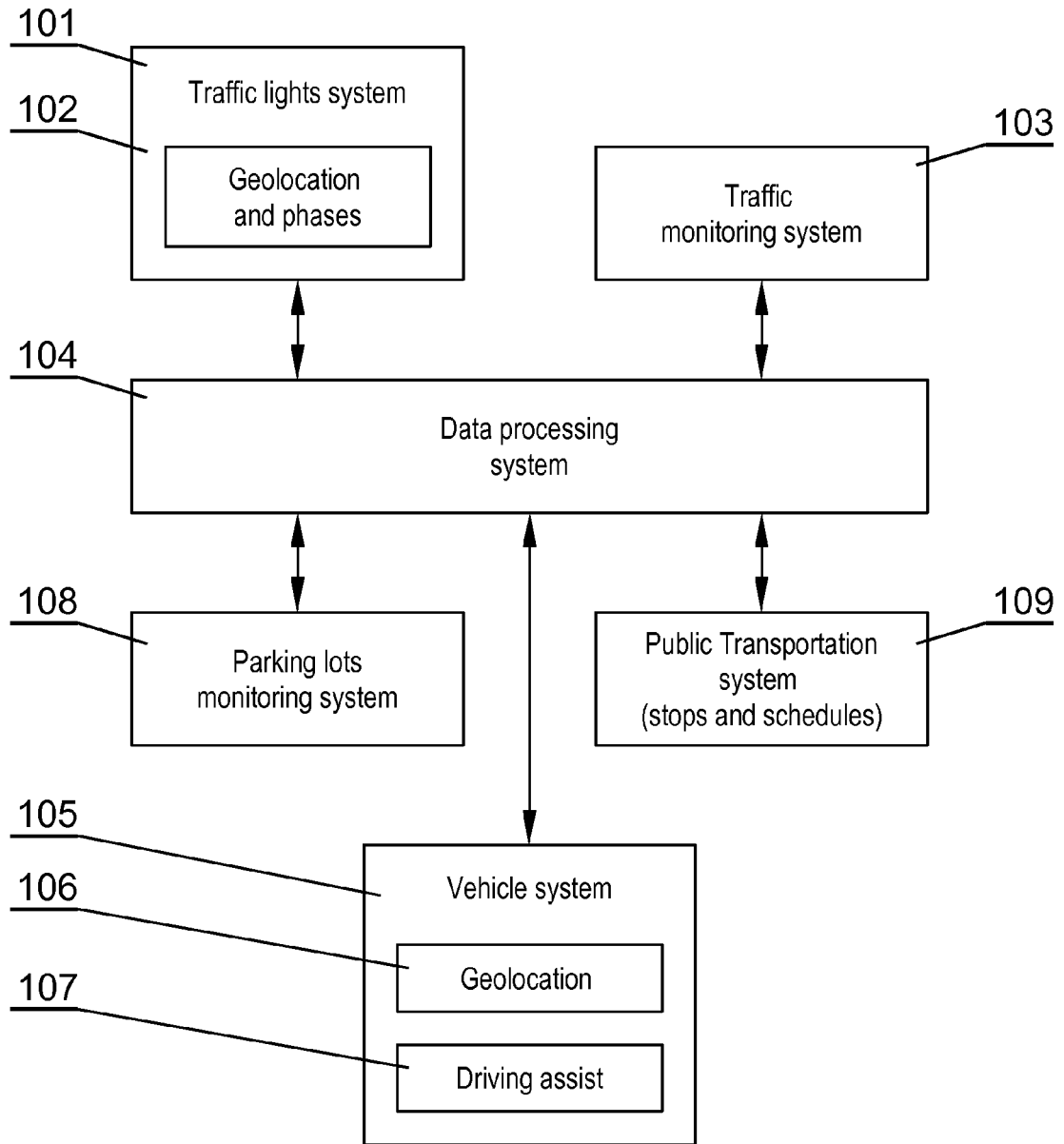


Fig. 1

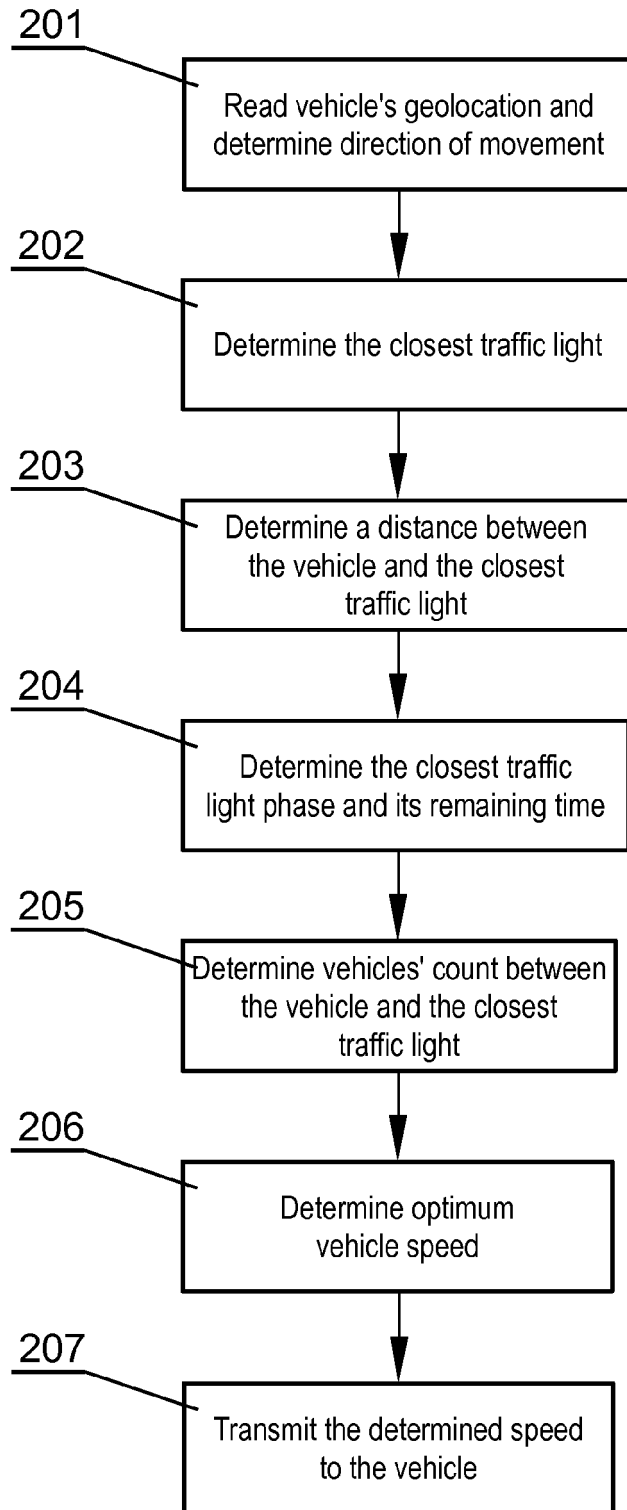


Fig. 2

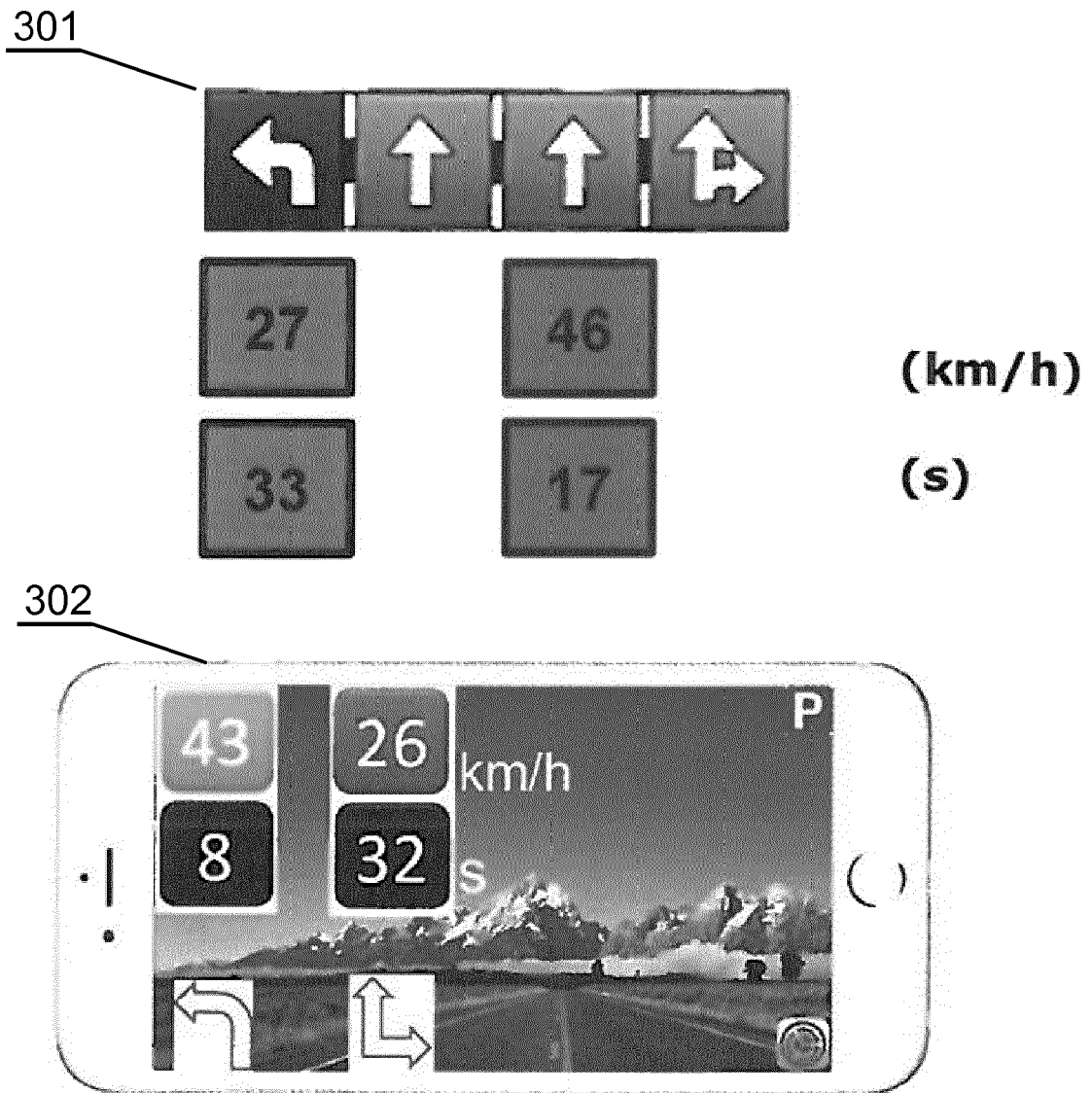


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 15 18 6413

5

10

15

20

25

30

35

40

45

50

55

| DOCUMENTS CONSIDERED TO BE RELEVANT | | | |
|--|--|---|---|
| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (IPC) |
| X | WO 2013/109472 A1 (ON TIME SYSTEMS INC [US]) 25 July 2013 (2013-07-25) * paragraph [0032] - paragraph [0033] * * paragraph [0039] * * paragraph [0057] * * paragraph [0065] * * paragraph [0073] * * paragraph [0003] * * paragraph [0047] * * paragraph [0020] * * paragraph [0054] * * paragraph [0025] * * paragraph [0053] * * * | 1-10 | INV. G08G1/01 G08G1/0967 |
| X | DE 10 2010 052702 A1 (AUDI AG [DE]) 31 May 2012 (2012-05-31) | 1,2,8-10 | TECHNICAL FIELDS SEARCHED (IPC) G08G |
| Y | * paragraph [0009] * * paragraph [0016] * * paragraph [0025] * * paragraph [0030] * | 3-7 | |
| X | DE 10 2012 006708 A1 (DAIMLER AG [DE]) 18 October 2012 (2012-10-18) * paragraph [0023] * * paragraph [0027] * * paragraph [0029] * * paragraph [0034] * * paragraph [0028] * | 1-3,5,8-10 | G08G |
| Y | DE 10 2009 042923 A1 (SIEMENS AG [DE]) 4 August 2011 (2011-08-04) | 3-7 | |
| A | * paragraph [0022] - paragraph [0024] * * paragraph [0037] * * paragraph [0037] - paragraph [0038] * * paragraph [0060] - paragraph [0061] * | 1,2,8-10 | |
| The present search report has been drawn up for all claims | | | |
| Place of search The Hague | | Date of completion of the search 9 February 2017 | Examiner de la Cruz Valera, D |
| CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document | | | |

EPO FORM 1503 03.02 (P04C01)

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

EP 15 18 6413

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

09-02-2017

10

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|--|------------------|-------------------------|------------------|
| WO 2013109472 A1 | 25-07-2013 | NONE | |
| ----- | | | |
| DE 102010052702 A1 | 31-05-2012 | NONE | |
| ----- | | | |
| DE 102012006708 A1 | 18-10-2012 | NONE | |
| ----- | | | |
| DE 102009042923 A1 | 04-08-2011 | NONE | |
| ----- | | | |

15

20

25

30

35

40

45

50

55

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 5519390 A [0004]
- US 20130110371 A [0005]