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(54) **System and method for providing information at a road sign**

System und Verfahren zur Bereitstellung von Informationen an einem Verkehrszeichen

Système et procédé pour fournir des informations au niveau d'un panneau de signalisation routière

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Description

[0001] The aim of the present invention is a system and a method for providing information at a road sign, in order to reduce traffic, optimize travel time and increase safety, especially within city limits.

[0002] Traffic congestion is a well-known problem, especially in cities with a high number of crossroads. Traffic flow may be optimized by providing systems for management of traffic lights, but these systems have a reactive nature - they may adapt the traffic light to actual traffic conditions, but have limited capabilities of impacting individual vehicles to optimize their movement.

[0003] Traffic management systems may be configured as a so-called 'green wave', where the main road has traffic lights configured such that a vehicle moving at a certain speed, for example 50 km/h, will reach the next traffic lights at a green light. The drawback of this system is that each driver shall maintain a particular optimal speed, for example 50 km/h, on the particular section of the road. However, in traffic conditions, a driver must adapt to other vehicles, which often means that it will not be possible to maintain the optimal speed in order to keep with the green wave. This especially happens when road sections between the traffic lights are long.

[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] There are also known from prior art so called highway led displays, presenting real-time information to drivers. Such display is for example disclosed in a PCT application WO2011107380 that discloses a system and method for managing information display for vehicles on cross roads. The system includes at least one panel to display a traffic regulatory information and advertisements.

[0006] Another prior art publication US 20110068950 A1 entitled "Traffic management systems and methods of informing vehicle operators of traffic signal states" discloses a traffic management system and method that determine and present a target speed for a vehicle to travel from a first position to a second position when a signaling device at the second position is in a desired phase. The target average speed can be presented via a variety of output devices, such as a display and/or speaker. The output device could, for example, be stationary, at a fixed distance from the signaling device, such as a roadside display. The output device could be a mobile device, carried in a vehicle or by a user, e.g., a cell phone, GPS navigation system, or personal digital assistant. The system can include a signal timing processor that determines a target average speed of travel between the first and second positions, which can be based on, or calculated from, timing information of the signals and a distance between the two positions.

[0007] Taking into account the aforementioned prior art publications, there exists a need to design a system and a method for providing information at a road sign, which will be useful for optimization of driving speed of individual vehicles and therefore may lead to reduction of overall traffic congestion.

[0008] The object of the invention is a computer-implemented method for providing information at a road sign and a road sign as defined in the claims.

[0009] The object of the invention has been presented in an exemplary embodiment in a drawing, in which:

Fig. 1 shows an exemplary traffic situation;
Fig. 2 presents a block diagram of the components of the system according to the present invention;
Fig. 3 presents example of the operational information on a traffic light;
Fig. 4A presents a general algorithm for calculating an optimal speed; and
Fig. 4B presents an algorithm for calculating an optimal speed for a plurality of traffic lights; and
Fig. 5 presents an exemplary user interface of a road sign.

[0010] Fig. 1 shows an exemplary traffic situation, wherein a vehicle approaches a traffic light 130 and is currently at a distance D from that traffic light.

[0011] According to the present invention there are located, at different places (e.g. at a road side or above road, along the road or at a crossroad), road signs 100 comprising displays 110 (for example LED or LCD screens). Each road sign 100 is configured with its location data that may be stored in the road sign display or set at a traffic information server 120 with which the road signs may be communicatively coupled (unidirectionally or bidirectionally), wherein the server 120 also communicates with the traffic lights 130. Alternatively, the road sign 100 may be equipped with a geolocalization module, such as GPS, in order to automatically determine and report its position.

[0012] Alternatively a new control module may be communicatively coupled to existing road signs comprising display screens but lacking the speed recommendation function as described herein.

[0013] Fig. 2 presents a diagram of the components of the system of the present invention.

[0014] The traffic information server 120 comprises a traffic lights database 121, which stores, for each traffic light 130 handled by the system, information about light cycle. The content of the information about the light cycle

may be dependent on the particular traffic lights management system used. For static systems, the information may include a list of light change times. For adaptive systems, the information may include only information about the next expected light change only, as the light may be operated adaptively to road conditions.

[0015] The database 121 may also store other information, such as whether the given traffic light 130 is synchronized with the clock of the server 120, information to which lane the traffic light applies, information on time at which the given traffic light is in an idle state (typically at night), information on speed limit in the vicinity of the traffic light. The server 120 is linked with the traffic lights 130 via a communication link 142.

[0016] The traffic information server 120 may further comprise a history database 122, configured to store statistical historical data, such as typical travel times between two identified traffic lights, preferably taking into account the time of the day, type of the day (workday, weekend day, national holiday etc.).

[0017] The history database 122 may be compiled based on traffic monitoring service. This data may be external of determined using different sensors and camera(s) present in the road sign 100.

[0018] Information from the traffic lights database 121 provides data describing current parameters of the environment, which are theoretical and may be not achievable in practice. For example, the speed limit allowable within the vicinity of the light may be in practice impossible to achieve in rush hours. The data from the traffic lights database 121 may be therefore corrected by data from historical database 122, e.g. specifying that the average achievable maximum speed in a particular rush hour is e.g. 10 km/h lower than the actual speed limit.

[0019] Data from the databases 121, 122 is processed by a data processor 123 and made accessible to users of the system by a data interface 124 as operational information on a particular traffic light 130.

[0020] Alternatively, the data interface 111 of the road sign can be communicatively connected (via a wired or wireless (e.g. GSM) interface) to the closest traffic light 130. This allows to handle traffic lights which are not connected to a centralized traffic information server.

[0021] An exemplary format of operational information on a traffic light is shown in Fig. 3.

[0022] The system may be organized as a Service Oriented Architecture (SOA). The system may be implemented in Web Services technology, which is a distributed implementation software components provided by SOAP (Simple Object Access Protocol). Service Components of Web Services can be implemented using a variety of programming languages, hardware platforms and operating systems. In order to facilitate implementation of client applications, service components of Web Services are described in WSDL (Web Services Description Language), so that developers of client applications can use automatic generators of communication code. A further development of the solution is UDDI (Universal Description, Discovery and Integration) databases specification allowing to collect information on online Web services available.

[0023] A road sign 100 comprises a data interface 111 for communicating with the data interface 124 of the server 120 via a communication link 141. The communication 141 may be effected via a dedicated communication channel, or via standard communication channels, such as the Internet.

[0024] The road sign 100 may optionally comprise a mapping system 114, which can be a dedicated or third-party system configured to provide a map of the environment. The mapping system 114 may be embedded within the memory of the road sign 100 or can be accessible via Internet. The mapping system 114 is linked to an optional geolocalization module 115, such as a Global Positioning System (GPS), that determines geographical coordinates of location of the road sign 110 (alternatively the geolocalization is hardcoded). The module may further comprise a database of traffic lights, defining the coordinates of the traffic lights 130 and their identifiers. Such mapping system can be used to automatically determine the closest traffic lights at which the road sign is installed. This is particularly useful when the road sign is a portable, non-stationary road sign, which can be installed at different places depending on needs to control the traffic within the city. Such road sign can automatically determine its position and orientation with respect to the closest traffic lights.

[0025] A data processor 112 is configured to determine an optimal speed at which a vehicle, being at a location of a given road sign display 100, should move in order to arrive at the closest traffic light 130 when it is at a green phase. A set of closest traffic lights in a given main direction may be considered in determining the optimal speed.

[0026] The speed recommendation may be provided for all available lanes and may differ depending on the lane. For example a recommendation for the left lane may be 45km/h, a recommendation for the middle lane may be 55km/h while a recommendation for the right lane may be 30km/h. This is useful when traffic lights have different cycles depending on respective lanes.

[0027] The optimal speed can be calculated based on the general algorithm shown in Fig. 4A. It starts in step 401 by determining the speed range at which the vehicle may reach the first green cycle of the traffic light (taking into account presence at the location of a given road sign 100), i.e. the current cycle if the traffic light is currently green or the next green cycle. Next, in step 402 the determined range is compared with a speed limit, which can be the lowest of:

- the maximum allowed speed limit for the vehicle, e.g. 130 km/h for passenger cars, 90 km/h for trucks, 30km/h for bicycles etc. (the road sign may comprise or be connected to appropriate vehicle type detector 140 to determine a type of the approaching vehicle

- for example such sensor may be a camera provided with a suitable recognition mechanism that may be implemented as software and executed by the data processor 112, alternatively a weight sensor or a coil sensor may be installed in the road surface at the vicinity of the road sign)
- a default speed limit set by the system, e.g. 50km/h;
- the maximum allowed speed limit determined by the mapping system 114 for the particular road region between the road sign 100 and the closest traffic light 130;
- the average speed determined by the history database 122 for travel between the particular road region between the road sign 100 and the traffic light 130 (which can be further dependent on the day of the week and time of day).

[0028] In case the speed range includes a value lower than the speed limit, an optimal speed is selected and provided to the road sign 100 in step 403. In case the whole speed range exceeds the speed limit, in step 404 the speed range to arrive at the next green cycle for the particular traffic light 130 is determined and the procedure returns to step 402.

[0029] The optimal speed in step 403 can be selected as one of:

- the average between the lowest value of the optimal speed range and the speed limit;
- the speed limit decreased by a predetermined value, such as 5km/h or 10%;
- the speed limit.

[0030] A skilled person will realize that the algorithm of Fig. 4A may be adapted by determining the optimal speed that will allow the vehicle to reach the green cycle at the closest traffic light and at the next traffic light. The next traffic light can be determined as the traffic light that is next in the direction of travel or a traffic light that is next on the route of travel planned in the mapping system 114.

[0031] Fig. 4B presents an algorithm for calculating an optimal speed for a plurality of traffic lights. Steps 411-414 are equivalent to steps 401-404 of Fig. 4A. Speed range 1 is the first speed range determined in step 411 that is between the minimum speed and the speed limit. Preferably, the highest speed of speed range 1 is output in step 413.

[0032] Next, in step 415 a second speed range is determined to arrive at the first green cycle at the next traffic light. In step 416 it is checked whether this speed range is within the speed limit and if not, the speed range is recalculated in step 418 for the following green cycle. If the speed range is within the speed limit, it is checked in step 417 whether the speed ranges calculated so far for all traffic lights have an intersection range. If there is an intersection range, in step 419 the optimal range is output and in step 420 a further speed range is calculated for a further traffic light. In case there is no intersection range, in step 421 the procedure determines speed range to arrive at the next green cycle at the next traffic light.

[0033] The procedure continues until the most optimal speed is found for a determined plurality of traffic lights.

[0034] The plurality of traffic lights may comprise traffic lights arranged consecutively along the main road at which the road sign is installed.

[0035] The optimal speed is displayed via a user interface 113 of the display 110 of the road sign 100, which may have a form as shown for example in Fig. 5. The user interface 501 may comprise a region speed information 503, the speed information including information about the current speed 504 of the vehicle approaching the road sign (where the speed is measured by a speed radar 130 integrated with the road sign or connected to the road sign), the optimal speed 505 and the traffic light cycle information 506 about when the next green cycle will start or how long will the green cycle last.

[0036] The current speed of a vehicle may be determined by means of a suitable sensor provided in the road sign (100).

[0037] Additional visual feedback may be provided, e.g. by highlighting the background of the interface, for example:

- to green if the current speed is within the calculated speed range or optimal speed;
- to red if the current speed is higher than the calculated speed range or optimal speed;
- to blue if the current speed is lower than the calculated speed range or optimal speed.

[0038] The additional feedback may also include comments such as "speed up" or "slow down".

[0039] In case the vehicle moves with a speed which is less than the calculated speed range or optimal speed for a relatively long period, it may suggest that the road is under heavy traffic conditions and it is not possible to achieve the expected optimal speed. In such a case the current speed may be used in step 402 as the speed limit to calculate the more optimal speed limit.

[0040] The procedures of Fig. 4A or 4B are preferably executed cyclically, e.g. every second, in order to provide to the user the most up-to-date information. The information may have to be updated due to the change of user's speed or a change of the traffic light cycle when adaptive traffic lights are used.

[0041] A skilled person will realize that the algorithms of Fig. 4A and 4B may be adapted to take into account the timing of yellow light, i.e. the periods between the green and red lights, without departing from the general inventive concept presented herein.

[0042] In order to maintain reliable service, in case of a remote database 101, a query result may also comprise a time stamp defining the time, at which it has been generated. The navigational module may then determine the time lag between the time at which the information about the light cycle was generated at the server 120 and at

which is was actually processed by the data processor 112.

[0043] In case the traffic information server provides information that a particular traffic light is non-functioning, a special alert may be displayed to the user upon entering the area in the vicinity of that traffic light, so as to warn the user about possible dangerous road situations.

[0044] It can be easily recognized, by one skilled in the art, that the aforementioned method for providing traffic information may be performed and/or controlled by one or more computer programs. Such computer programs can be executed by utilizing the computing resources of a processor installed in the road sign device. Applications are stored in non-volatile memory, for example a flash memory or volatile memory, for example RAM and 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 the technical concept presented herein.

[0045] In another exemplary embodiment the aforementioned method for vehicle management in traffic conditions may be performed and/or controlled by one or more specialized hardware modules wherein the logic of the present invention is embedded in programmable hardware circuits such as field-programmable gate array (FPGA). This would specially configure the device to execute functions presented in the foregoing specification.

[0046] 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.

[0047] 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 computer-implemented method for providing information at a road sign (110) comprising a display (110), the method comprising the steps of:

    • identifying the closest traffic light (130) ahead the road sign (100);
    • retrieving operational information on the identified closest traffic light (130);
    • processing the operational information to determine an optimal speed at which vehicles present in proximity to the location of the road sign (100) should move to arrive at the closest traffic light (130) when it is at green phase; and
    • outputting the optimal speed via the display (110);

    the method being **characterized in that** it further comprises the steps of:

    • determining (401, 411) a first speed range necessary to arrive at a first green cycle of the closest traffic light (130);
    • comparing (402, 412) the first speed range with a speed limit;
    • in case the first speed range is higher than the speed limit, determining (404, 414) a next speed range necessary to arrive at the next green cycle of the closest traffic light (130) until the next speed range is lower than the speed limit;
    • determining (403, 413) the optimal speed as a speed not greater than the speed limit;
    • outputting via the display (110) of the road sign (100), an indicator specifying whether the current speed of a vehicle approaching the road sign is within the determined speed range, lower than the determined speed range or higher than the determined speed range.

2. The method according to claim 1, wherein the operational information on the identified closest traffic light (130) is retrieved from a remote traffic light server (120).

3. The method according to claim 1, wherein the optimal speed for a plurality of traffic lights is further determined by:

    • determining (415) a second speed range necessary to arrive at the first green cycle of the next traffic light (130);
    • comparing (416) the second speed range with a speed limit;
    • in case the second speed range includes a range lower than the speed limit, determining (417) the second optimal speed as not greater than the speed limit and outputting (419) an optimal speed which is in the range of intersection of the first speed range and the second speed range; and
    • otherwise, determining (418) the speed range necessary to arrive at the next green cycle of the closest traffic light (130),

4. The method according to claim 1, wherein the speed limit is selected depending on the type of the vehicle.

5. The method according to claim 1, wherein the speed limit is determined as the maximum allowed speed limit determined by a mapping system (114) for the particular road region between the vehicle and the

closest traffic light (130).

6. The method according to claim 1, wherein the speed limit is determined as an average speed stored in a history database (122) for travel between the particular road region between the road sign (100) and the traffic light (130).

7. The method according to any of previous claims, further comprising obtaining geolocalization data of the road sign (100) and identifying the closest traffic light (130) ahead the road sign (100) based on the geolocalization data.

8. A computer program comprising program code means for performing all the steps of the computer-implemented method according to any of claims 1 - 8 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 any of claims 1 - 7 when executed on a computer.

10. A road sign (110), comprising a display (110) for providing information for vehicles, the road sign comprising:

- a data interface (111) configured to retrieve operational information on the closest traffic light (130);
- a data processor (112) configured to process the operational information to determine an optimal speed at which vehicles in proximity to the location of the road sign should move to arrive at the closest traffic light (130) when it is at green phase;
- a user interface (113) configured to output the optimal speed by means of the display (110)

the road sign being **characterized in that**:

- the data processor (112) is configured to:
  - determine (401, 411) a first speed range necessary to arrive at a first green cycle of the closest traffic light (130);
  - compare (402, 412) the first speed range with a speed limit;
  - in case the first speed range is higher than the speed limit, determine (404, 414) a next speed range necessary to arrive at the next green cycle of the closest traffic light (130) until the next speed range is lower than the speed limit;
  - determine (403, 413) the optimal speed as a speed not greater than the speed limit;
- and the user interface (113) is configured to output an indicator specifying whether the current speed of a vehicle approaching the road sign is within the calculated speed range, lower than the determined speed range or higher than the determined speed range.

11. The road sign according to claim 10, wherein the data interface (111) is communicatively connected to a remote traffic light server (120).

12. The road sign according to claim 11, wherein the data interface (111) is communicatively connected to the closest traffic light (130).

Patentansprüche

1. Computerimplementiertes Verfahren zum Bereitstellen von Informationen an einem Straßenschild (100), umfassend eine Anzeige (110), wobei das Verfahren folgende Schritt umfasst:

- Identifizieren der nächstgelegen Ampel (130) hinter dem Straßenschild (100);
- Abrufen von Betriebsinformationen zu der identifizierten nächstgelegenen Ampel (130);
- Verarbeiten der Betriebsinformationen zum Bestimmen einer optimalen Geschwindigkeit, mit der sich Fahrzeuge, die sich in der Nähe der Position des Straßenschildes (100) befinden, bewegen sollten, um an der nächstgelegenen Ampel (130) anzukommen, wenn sie eine Grünphase hat; und
- Ausgabe der optimalen Geschwindigkeit über die Anzeige (110);

wobei das Verfahren **dadurch gekennzeichnet ist, dass** es ferner die folgenden Schritte umfasst:

- Bestimmen (401, 411) eines ersten Geschwindigkeitsbereichs, der erforderlich ist, um in einem ersten Grünzyklus der nächstgelegenen Ampel (130) anzukommen;
- Vergleichen (402, 412) des ersten Geschwindigkeitsbereichs mit der Geschwindigkeitsbegrenzung;
- im Falle, dass der Geschwindigkeitsbereich höher ist als die Geschwindigkeitsbegrenzung, das Bestimmen (404, 414) eines nächsten Geschwindigkeitsbereichs, der erforderlich ist, um in dem nächsten Grünzyklus der nächsten Ampel (130) anzukommen, bis der nächste Geschwindigkeitsbereich niedriger ist als die Geschwindigkeitsbegrenzung;
- Bestimmen (403, 413) der optimalen Geschwindigkeit als eine Geschwindigkeit, die nicht größer ist als die Geschwindigkeitsbegren-

zung;

• Ausgeben eines Indikators auf der Anzeige (110) des Straßenschildes (100), der spezifiziert, ob die aktuelle Geschwindigkeit eines Fahrzeugs, das sich einem Straßenschild nähert, innerhalb des bestimmten Geschwindigkeitsbereichs liegt, niedriger als der bestimmte Geschwindigkeitsbereich ist oder höher als der bestimmte Geschwindigkeitsbereich ist.

2. Verfahren nach Anspruch 1, wobei die Betriebsinformationen zu der identifizierten nächstgelegenen Ampel (130) von einem entfernten Ampelserver (120) abgerufen werden.

3. Verfahren nach Anspruch 1, wobei die optimale Geschwindigkeit für eine Mehrzahl von Ampeln ferner bestimmt wird durch:

• Bestimmen (415) eines Sekundengeschwindigkeitsbereichs, der erforderlich ist, um an dem ersten Grünzyklus der nächsten Ampel (130) anzukommen;

• Vergleichen (416) des Sekundengeschwindigkeitsbereichs mit einer Geschwindigkeitsbegrenzung;

• im Falle, dass der Sekundengeschwindigkeitsbereich einen Bereich umfasst, der niedriger ist als die Geschwindigkeitsbegrenzung, das Bestimmen (417) der zweiten optimalen Geschwindigkeit als eine, die nicht größer ist als die Geschwindigkeitsbegrenzung, und Ausgeben (419) einer optimalen Geschwindigkeit, die in dem Überschneidungsbereich des ersten Geschwindigkeitsbereichs und des zweiten Geschwindigkeitsbereichs liegt; und

• Andernfalls Bestimmen (418) des Geschwindigkeitsbereichs, der erforderlich ist, um in dem nächsten Grünzyklus der nächstgelegenen Ampel (130) anzukommen.

4. Verfahren nach Anspruch 1, wobei die Geschwindigkeitsbegrenzung in Abhängigkeit von dem Fahrzeugtyp ausgewählt wird.

5. Verfahren nach Anspruch 1, wobei die Geschwindigkeitsbegrenzung mittels eines Kartensystems (114) für die bestimmte Straßenregion zwischen dem Fahrzeug und der nächstgelegenen Ampel (130) als die maximal zulässige Geschwindigkeitsbegrenzung bestimmt wird.

6. Verfahren nach Anspruch 1, wobei die Geschwindigkeitsbegrenzung als eine Durchschnittsgeschwindigkeit bestimmt ist, die in einer Verlaufsdatenbank (122) zum Bewegen innerhalb des bestimmten Straßenbereichs zwischen dem Straßenschild (100) und der Ampel (130) gespeichert ist.

7. Verfahren nach einem der vorstehenden Ansprüche, ferner das Erhalten von Geolokalisierungsdaten des Straßenschildes (100) und das Identifizieren der nächstgelegenen Ampel (130) hinter dem Straßenschild (100) auf Grundlage der Geolokalisierungsdaten umfassend.

8. Computerprogramm, umfassend Programmcodemittel zum Ausführen aller Schritte des computerimplementierten Verfahrens nach einem der Ansprüche 1-8, wenn das Programm auf einem Computer abgespielt wird.

9. Computerlesbares Medium, das computerausführbare Anweisungen speichert, welches all die Schritte des computerimplementierten Verfahrens nach einem der Ansprüche 1-7 ausführt, wenn es auf einem Computer abgespielt wird.

10. Straßenschild (100), umfassend eine Anzeige (110) zum Bereitstellen von Informationen für Fahrzeuge, wobei das Straßenschild umfasst:

• eine Datenschnittstelle (111), die so konfiguriert ist, dass sie Betriebsinformationen zu der nächstgelegenen Ampel (130) abruft;

• einen Datenprozessor (112), der so konfiguriert ist, dass er die Betriebsinformationen verarbeitet, um eine optimale Geschwindigkeit zu bestimmen, bei der sich Fahrzeuge in der Nähe der Position des Straßenschildes bewegen sollten, um an der nächstgelegenen Ampel (130) anzukommen, wenn sie eine Grünphase hat;

• eine Benutzeroberfläche (113), die so konfiguriert ist, dass sie die optimale Geschwindigkeit mittels der Anzeige (110) ausgibt,

wobei das Straßenschild **dadurch gekennzeichnet ist, dass**:

• der Datenprozessor (112) so konfiguriert ist, dass er:

◦ einen ersten Geschwindigkeitsbereich bestimmt (401, 411), der erforderlich ist, um bei einem ersten Grünzyklus der nächstgelegenen Ampel (130) anzukommen;

◦ den ersten Geschwindigkeitsbereich mit einer Geschwindigkeitsbegrenzung vergleicht (402, 412);

◦ im Falle, dass der erste Geschwindigkeitsbereich höher als die Geschwindigkeitsbegrenzung ist, einen nächsten Geschwindigkeitsbereich bestimmt (404, 414), der erforderlich ist, um bei dem nächsten Grünzyklus der nächstgelegenen Ampel (130) anzukommen bis der nächste Geschwindigkeitsbereich niedriger als die Geschwindig-

keitsbegrenzung ist;
◦ die optimale Geschwindigkeit als eine Geschwindigkeit bestimmt (403, 413), die nicht größer als die Geschwindigkeitsbegrenzung ist;
◦ und die Benutzeroberfläche (113) so konfiguriert ist, dass sie einen Indikator ausgibt, der spezifiziert, ob die aktuelle Geschwindigkeit des Fahrzeugs, das sich dem Straßenschild nähert, innerhalb des berechneten Geschwindigkeitsbereichs liegt, niedriger als der bestimmte Geschwindigkeitsbereich ist oder höher als der bestimmte Geschwindigkeitsbereich ist.

11. Straßenschild nach Anspruch 10, wobei die Datenschnittstelle (111) kommunikativ mit einem entfernten Ampelserver (120) verbunden ist.

12. Straßenschild nach Anspruch 11, wobei die Datenschnittstelle (111) kommunikativ mit der nächstgelegenen Ampel (130) verbunden ist.

Revendications

1. Procédé mis en oeuvre par ordinateur destiné à fournir des informations au niveau d'un panneau de signalisation routière (100) comprenant un écran (110), le procédé comprenant les étapes consistant à :

• identifier le feu de signalisation le plus proche (130) avant le panneau de signalisation routière (100) ;
• récupérer des informations opérationnelles sur le feu de signalisation le plus proche identifié (130) ;
• traiter les informations opérationnelles pour déterminer la vitesse optimale à laquelle les véhicules présents à proximité de l'emplacement du panneau de signalisation routière (100) devraient se déplacer pour arriver au feu de signalisation le plus proche (130) lorsqu'il est au vert ; et
• transmettre la vitesse optimale par le biais de l'écran (110) ;

ledit procédé étant **caractérisé en ce qu'**il comprend en outre les étapes consistant à :

• déterminer (401, 411) une première plage de vitesses nécessaire pour arriver à un premier cycle de vert du feu de signalisation le plus proche (130) ;
• comparer (402, 412) la première plage de vitesse à la limite de vitesse ;
• dans le cas où la première plage de vitesses est supérieure à la limite de vitesse, déterminer (404, 414) une plage de vitesses suivante pour arriver au cycle de vert suivant du feu de signalisation le plus proche (130) jusqu'à ce que la plage de vitesses suivante soit inférieure à la limite de vitesse ;
• déterminer (403, 413) la vitesse optimale en tant que vitesse non supérieure à la limite de vitesse ;
• transmettre par le biais l'écran (110) du panneau de signalisation routière (100), un indicateur précisant si la vitesse courante d'un véhicule approchant du panneau de signalisation routière se trouve dans la plage de vitesses déterminée, est inférieure à la plage de vitesses déterminée ou est supérieure à la plage de vitesses déterminée.

2. Procédé selon la revendication 1, lesdites informations opérationnelles sur le feu de signalisation le plus proche identifié (130) étant récupérées à partir d'un serveur de feu de signalisation distant (120).

3. Procédé selon la revendication 1, ladite vitesse optimale pour une pluralité de feux de signalisation étant en outre déterminée en :

• déterminant (415) une seconde plage de vitesses nécessaire pour arriver au premier cycle de vert du feu de signalisation suivant (130) ;
• comparant (416) la seconde plage de vitesses à la limite de vitesse ;
• dans le cas où la seconde plage de vitesses comprend une plage inférieure à la limite de vitesse, déterminant (417) la seconde vitesse optimale en tant que vitesse non supérieure à la limite de vitesse et transmettant (419) la vitesse optimale qui se trouve dans la plage d'intersection de la première plage de vitesses et de la seconde plage de vitesses ; et
• par ailleurs, déterminant (418) la plage de vitesses nécessaire pour arriver au cycle de vert suivant du feu de signalisation le plus proche (130).

4. Procédé selon la revendication 1, ladite limite de vitesse étant choisie selon le type de véhicule.

5. Procédé selon la revendication 1, ladite limite de vitesse étant déterminée en tant que limite de vitesse maximale autorisée déterminée par un système de cartographie (114) pour la région routière particulière située entre le véhicule et le feu de signalisation le plus proche (130).

6. Procédé selon la revendication 1, ladite limite de vitesse étant déterminée en tant que vitesse moyenne stockée dans une base de données d'historique

(122) pour le déplacement dans la région routière particulière située entre le panneau de signalisation routière (100) et le feu de signalisation (130).

7. Procédé selon l'une quelconque des revendications précédentes, comprenant en outre l'obtention de données de géolocalisation du panneau de signalisation routière (100) et l'identification du feu de signalisation le plus proche (130) avant le panneau de signalisation (100) sur la base des données de géolocalisation.

8. Programme informatique comprenant un moyen de code de programme destiné à effectuer toutes les étapes du procédé mis en oeuvre par ordinateur selon l'une quelconque des revendications 1 à 8 lorsque ledit programme est exécuté sur un ordinateur.

9. Support lisible par ordinateur stockant des instructions exécutables par ordinateur effectuant toutes les étapes du procédé mis en oeuvre par ordinateur selon l'une quelconque des revendications 1 à 7 lorsqu'il est exécuté sur un ordinateur.

10. Panneau de signalisation routière (100), comprenant un écran (110) destiné à fournir des informations pour des véhicules, le panneau de signalisation routière comprenant :

- une interface de données (111) configurée pour récupérer des informations opérationnelles sur le feu de signalisation le plus proche (130) ;
- un processeur de données (112) configuré pour traiter les informations opérationnelles afin de déterminer la vitesse optimale à laquelle les véhicules à proximité de l'emplacement du panneau de signalisation routière devraient se déplacer pour arriver au feu de signalisation le plus proche (130) lorsqu'il est au vert ;
- une interface utilisateur (113) configurée pour transmettre la vitesse optimale au moyen de l'écran (110);

le panneau de signalisation routière étant **caractérisé en ce que** :

- le processeur de données (112) est configuré pour :
  - déterminer (401, 411) une première plage de vitesses nécessaire pour arriver à un premier cycle de vert du feu de signalisation le plus proche (130) ;
  - comparer (402, 412) la première plage de vitesse à la limite de vitesse ;
  - dans le cas où la première plage de vitesse est supérieure à la limite de vitesse, déterminer (404, 414) une plage de vitesses suivante nécessaire pour arriver au cycle de vert suivant du feu de signalisation le plus proche (130) jusqu'à ce que la plage de vitesse suivante soit inférieure à la limite de vitesse ;
  - déterminer (403, 413) la vitesse optimale en tant que vitesse non supérieure à la limite de vitesse ;

- et l'interface utilisateur (113) est configurée pour transmettre un indicateur précisant si la vitesse courante d'un véhicule approchant du panneau de signalisation routière se trouve dans la plage de vitesses calculée, est inférieure à la plage de vitesses déterminée ou est supérieure à la plage de vitesses déterminée.

11. Panneau de signalisation routière selon la revendication 10, ladite interface de données (111) étant reliée de façon communicante à un serveur de feu de signalisation distant (120).

12. Panneau de signalisation routière selon la revendication 11, ladite interface de données (111) étant reliée de façon communicante au feu de signalisation le plus proche (130).

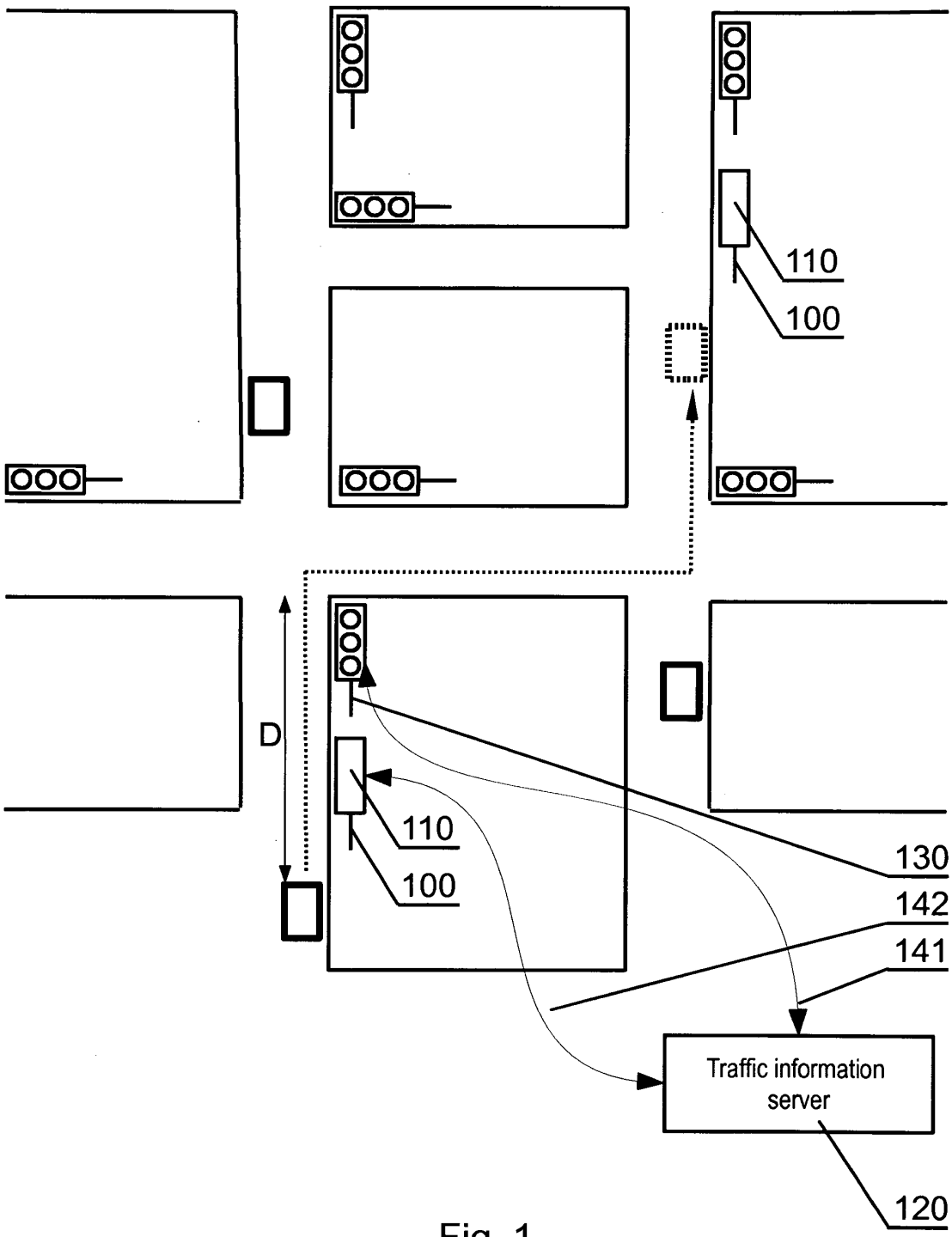

Fig. 1

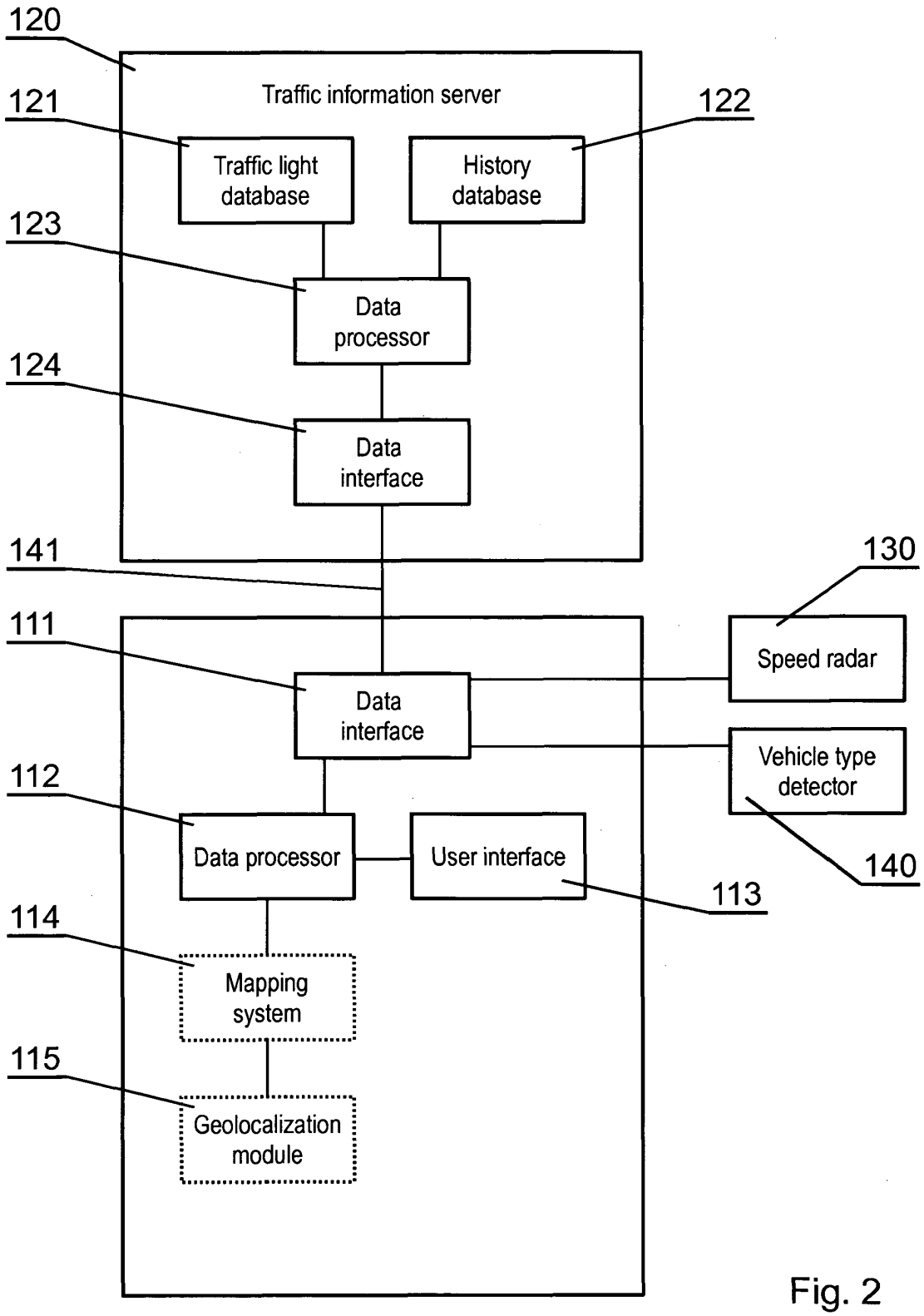
120
Traffic information server
121
122
Traffic light database
History database
123
Data processor
124
Data interface
141
130
111
Speed radar
Data interface
Vehicle type detector
112
140
Data processor
User interface
113
114
Mapping system
115
Geolocalization module

Fig. 2

Traffic light: ID_131

Next red in:	10s
Next green in:	30s
Green cycle:	30s
Red cycle:	30s

Fig. 3

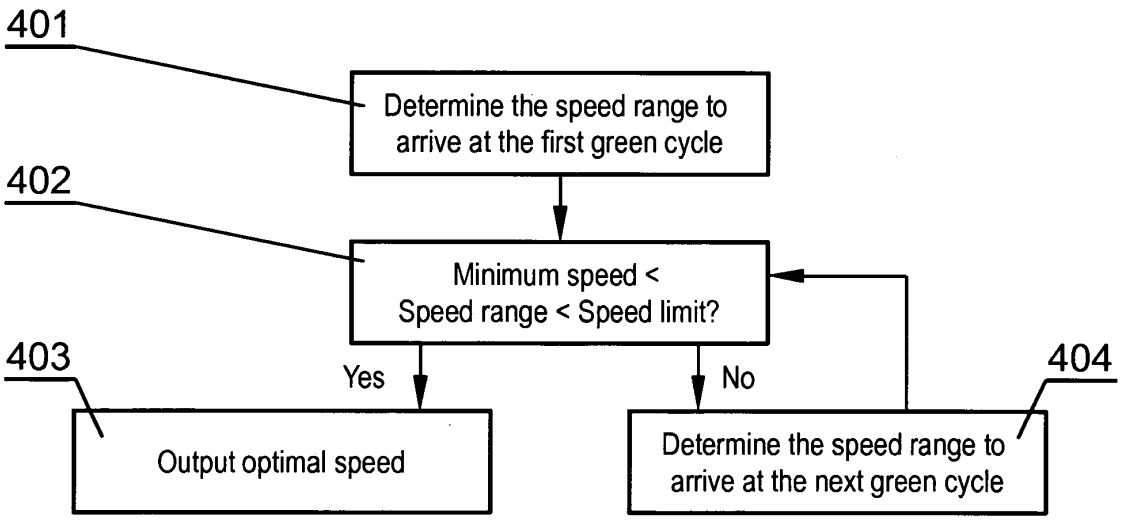

Fig. 4A

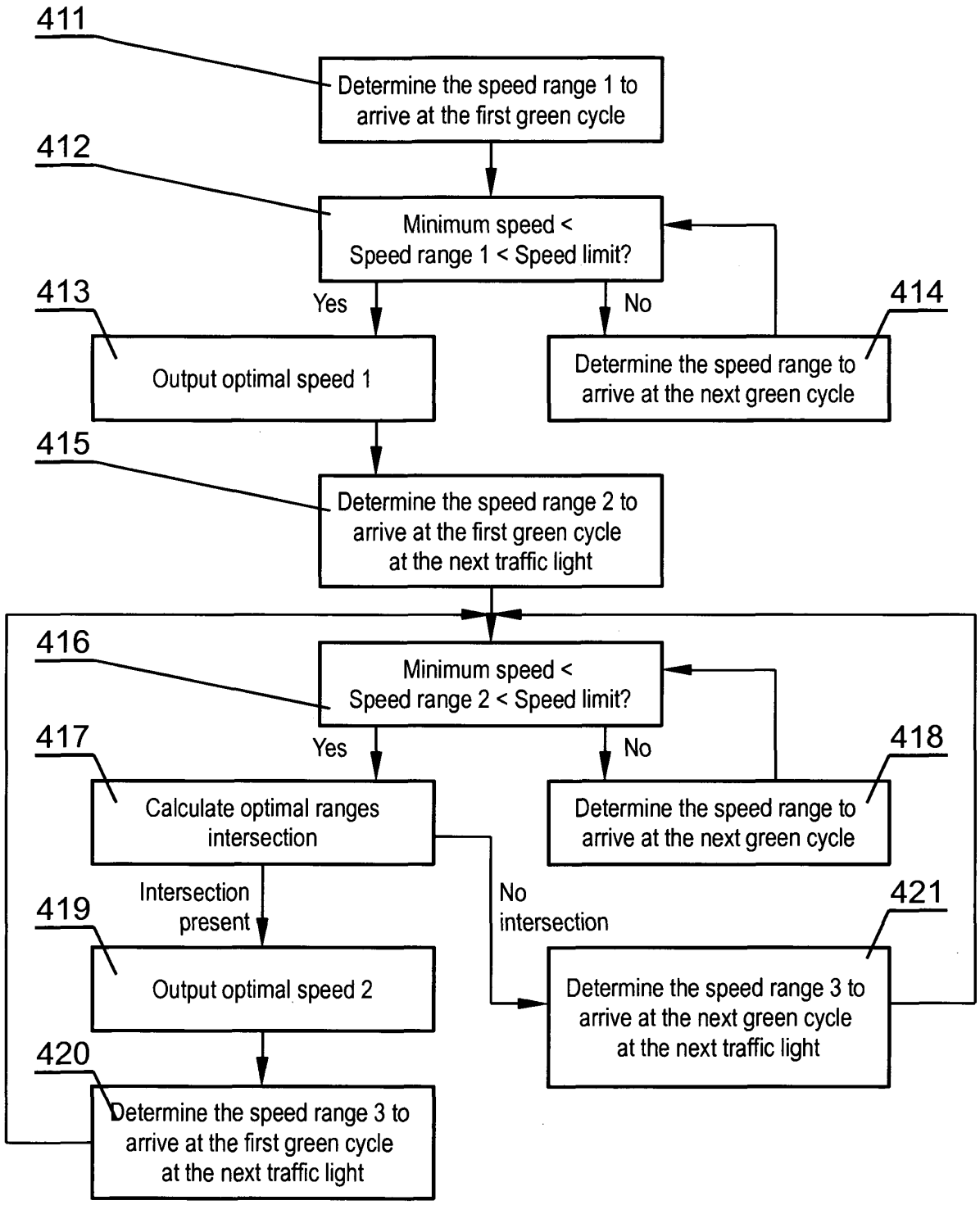
411
Determine the speed range 1 to arrive at the first green cycle
412
Minimum speed < Speed range 1 < Speed limit?
Yes
No
413
Output optimal speed 1
414
Determine the speed range to arrive at the next green cycle
415
Determine the speed range 2 to arrive at the first green cycle at the next traffic light
416
Minimum speed < Speed range 2 < Speed limit?
Yes
No
417
Calculate optimal ranges intersection
418
Determine the speed range to arrive at the next green cycle
Intersection present
No intersection
419
Output optimal speed 2
421
Determine the speed range 3 to arrive at the next green cycle at the next traffic light
420
Determine the speed range 3 to arrive at the first green cycle at the next traffic light

Fig. 4B

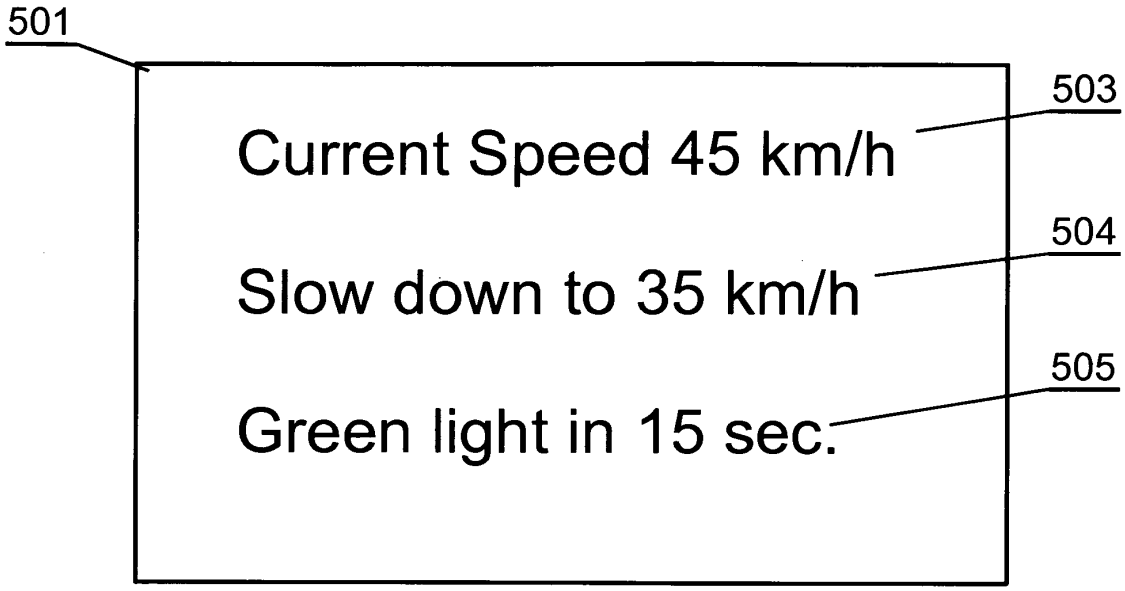
501
503
Current Speed 45 km/h
504
Slow down to 35 km/h
505
Green light in 15 sec.

Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5519390 A **[0004]**
- WO 2011107380 A **[0005]**
- US 20110068950 A1 **[0006]**