



(11) **EP 3 098 785 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
30.11.2016 Bulletin 2016/48

(51) Int Cl.:
G07C 11/00 (2006.01) G06Q 50/30 (2012.01)

(21) Application number: **15380020.6**

(22) Date of filing: **29.05.2015**

(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) Inventor: **Gomà Huguet, Anton**
08172 Sant Cugat del Vallès (Barcelona) (ES)

(74) Representative: **Juncosa Miro, Jaime et al**
Torner, Juncosa i Associates, S.L.
Gran Via de les Corts
Catalanes, 669 bis, 1^o, 2^a
08013 Barcelona (ES)

(71) Applicant: **CRTL4 Enviro, S.L.**
25200 Cervera (ES)

(54) **SYSTEM AND METHOD FOR CONTROLLING OPERATING CONDITIONS OF A MEANS OF TRANSPORT**

(57) The present invention relates to a system and method for controlling the operative conditions of a means of transport,

The system comprises:

- an information acquisition means (11) for obtaining digital data with information relating to the number of persons (1) present in a specific area of interest (Z) close to an access to the means of transport (10), without revealing the identity;

- a computing unit (12) for processing said obtained digital data performing a first calculation of the number of persons (1) present in said specific area of interest (Z); and
- a control unit of said means of transport (10) for dynamically modulating the operative conditions of the means of transport (10) including variation of its speed or adaptation of the transport units forming it or its frequency according to at least one value resulting from said first calculation.

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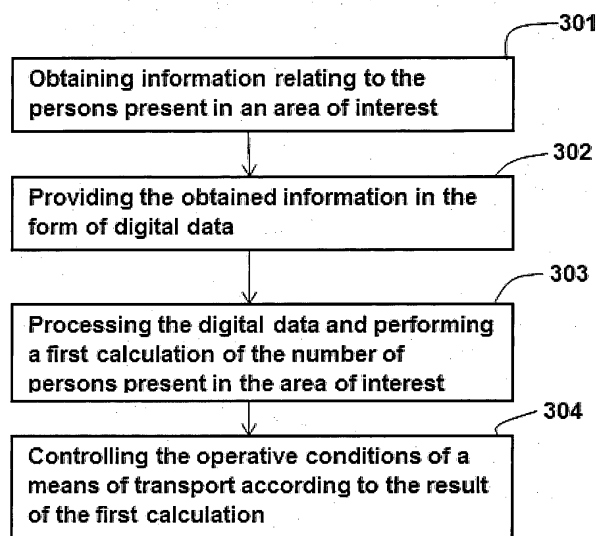


Fig. 3

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Description

Technical field

[0001] The present invention relates generally to systems and methods for controlling a transport vehicle depending on the persons to be transported. Particularly, the present invention relates to a system and a method for controlling the operative conditions of a means of transport, operating particularly in a closed circuit, based on prior detection and counting of the number of persons present in an area close to the means of transport and ready to use the same, keeping said persons anonymous.

Background of the Invention

[0002] International patent application WO-A2-2008142238 discloses a method for determining the number of persons present in a specific region or area at a specific time using an infrared thermal camera. The mentioned method divides the region into a set of subregions performing calculation of the mean temperature of each subregion. It then compares each mean temperature with a reference temperature. Finally, the subregions having a value resulting from the comparison that is above a reference threshold value are multiplied by a specific coefficient expressing the mean density of the number of persons in the subregions and a Fig. showing the number of persons is obtained from the sum.

[0003] Patents US-B1-6,195,121 and US-B2-7,652,687 disclose other methods for calculating the number of persons present in an area, particularly in a queue in a shop, airport, concert, museum, etc., and for allowing evaluation of the waiting time in the mentioned area in this manner.

[0004] In addition, Japanese patent JP-B2-3405793 discloses a system for detecting pedestrians waiting to cross a zebra crossing based on images obtained by a thermal camera for configuring and controlling a traffic light (the mentioned traffic light turns green or red depending on the pedestrians waiting to cross the zebra crossing).

[0005] However, means of transport, preferably operating in a closed circuit (for example a ski lift of a ski station, a monorail, a tramway, etc.), the operative conditions of which are controlled (increasing or reducing its speed or frequency, modifying the number of units/cars forming it in a specific time period, etc.) depending on how full it is, for example, its access area, i.e., the waiting area accommodating the persons waiting to access the means of transport, is not known up until today.

Description of the Invention

[0006] According to a first aspect, the present invention provides a system for controlling the operative conditions of a means of transport, comprising:

- an information acquisition means suitable and configured for obtaining digital data with information relating to the number of persons present (without revealing their identity) in a specific area of interest close to (or near) an access or accesses to a transport vehicle or means of transport;
- a computing unit in communication with the information acquisition means and including one or more processors running a computing algorithm for processing the mentioned obtained digital data, wherein the mentioned processing includes a first calculation of the number of persons present in the specific area of interest; and
- a control unit of the means of transport in connection with the computing unit for receiving said first calculation that is performed, for example, by means of a wireless technology, suitable and configured for dynamically modulating the operative conditions of the means of transport including, for example, its speed, or adaptation/modification of the number of transport units forming it, or even its frequency, according to a value resulting from said first calculation.

[0007] In one embodiment, said control unit is also connected to a regulation and/or measurement device for regulating and/or measuring the speed conditions or the number of transport units or the frequency of the means of transport.

[0008] In one embodiment, the information acquisition means comprises one or more thermal cameras covering the specific area of interest, or waiting area, and the obtained digital data is one or more images in the infrared spectrum encompassing the specific area of interest.

[0009] In another embodiment, the information acquisition means comprises one or more visible-spectrum digital cameras covering the specific area of interest, or waiting area, and the obtained digital data is one or more images encompassing the specific area of interest. To prevent revealing the identity of the persons, the mentioned visible-spectrum digital cameras must have a definition that is sufficient for detecting the persons but not sufficient for recognizing or identifying them. The mentioned definition is preferably less than 1 pixel/cm of scene.

[0010] In yet another embodiment, the information acquisition means comprises one or more turnstiles (or mechanical information acquisition systems) located in an area prior to the specific area of interest, or waiting area, through which the persons access the specific area of interest.

[0011] The means of transport is preferably a means operating in a closed circuit, being able to comprise a ski lift (for example, a chairlift, a gondola lift, a drag lift, etc.) or alternatively, a monorail or any means of transport having similar characteristics of adjustable capacity by varying the number of units (carriages/cars) forming it (for example a tramway) in a specific time period or operative cycle.

[0012] According to a second aspect, the present invention also provides a method for controlling the operative conditions of a means of transport (for example a ski lift or a monorail), wherein information relating to the number of persons present in a specific area of interest close to (or near) an access to the means of transport is first obtained by means of at least one information acquisition means, without revealing the identity of said persons, the mentioned information being provided in the form of digital data. The obtained digital data is then processed by means of a computing unit with one or more processors running a computing algorithm, in communication with the information acquisition means. The mentioned processing includes at least a first calculation of the number of persons present in the area of interest close to the access or accesses to the means of transport. Finally, the operative conditions of the means of transport are dynamically modulated in the proposed method based on a value resulting from said first calculation, for example, varying its speed within a parameterizable range in a manner proportional to the calculated number or adapting the number of transport units (carriages/cars) forming it or its frequency.

[0013] In a preferred embodiment, the first calculation further comprises calculating or estimating the waiting time of the mentioned persons in the specific area of interest.

[0014] For example, for the case of a ski lift, the speed thereof could be varied within specific ranges comprising 3 m/s for a minimum speed value and 5 m/s for a maximum speed value (the minimum and maximum speed ranges being approximate ranges and are in no way limiting). Variation of the speed of the ski lift to a minimum value would preferably correspond to the case in which there were no one waiting in the area of interest, whereas variation of the speed to a maximum value would correspond to the case in which the number of calculated persons were greater than a pre-established threshold value (e.g., more than 10 persons, 20 persons, etc.). Likewise, said variation to a maximum speed value would correspond to the case in which the waiting time for the persons in the area of interest were greater than a pre-established time period (e.g., 1 minute, 5 minutes, etc.), for example.

[0015] In one embodiment, the mentioned dynamic modulation of the operative conditions of the means of transport is performed taking into consideration, furthermore, a second calculation based on an optimization index of the means of transport. This optimization index is calculated from the first calculation and is preferably parameterizable by a user (such as an operator of the means of transport), for example, considering one or more of the following criteria: obtaining a better compromise between the waiting time and the power consumption, the availability of the number of transport units at a specific moment or time period, the need to introduce a maximum speed minutes before closure thereof, etc. In one embodiment, the processing of the obtained digital data is performed in real time simultaneously with the

reception of the digital data obtained through the information acquisition means. The processing of the obtained digital data is alternatively performed after the digital data has been received, and to that end, stored in at least one memory of the computing unit.

[0016] The dynamic modulation of the operative conditions of the means of transport in a preferred embodiment comprises varying, i.e., increasing and/or reducing, within a parameterizable range, the speed of the means of transport proportionally to the variation of the waiting time calculated in said first calculation, the value resulting from the first calculation being transmitted by the computing unit to a control unit of the means of transport.

[0017] Likewise, the mentioned dynamic modulation can comprise a computer dialogue with a regulation device for regulating the speed conditions, number of transport units or frequency of the means of transport, for adapting a decision concerning a change in one or more of said elements over time.

Brief Description of the Drawings

[0018] The foregoing and other features and advantages will be better understood based on the following detailed description of several merely illustrative and non-limiting embodiments in reference to the attached drawings, in which:

Fig. 1 schematically illustrates an example of the elements included in a system for controlling the operative conditions of a means of transport according to one embodiment of the present invention.

Fig. 2 schematically illustrates another embodiment of a system for controlling the operative conditions of a means of transport.

Fig. 3 is a flow chart illustrating an embodiment of a method for controlling the operative conditions of a means of transport which can be implemented in any of the systems of Figs. 1 and 2.

Detailed Description of several Embodiments

[0019] Fig. 1 shows a first embodiment of the system for controlling the operative conditions of a means of transport proposed by the first aspect of the invention. The system includes an information acquisition means 11 formed by a thermal camera covering a specific area of interest Z close to (or near) an access to the means of transport 10, in this particular case, a ski lift of a ski station, for obtaining digital data formed by one or more images in the infrared spectrum of the specific area of interest Z, and including information relating to the persons 1 present in the mentioned specific area of interest Z, waiting to access the ski lift 10, without revealing the identity of the persons.

[0020] Likewise, the system of Fig. 1 includes a com-

puting unit 12 in communication with the mentioned thermal camera (through communication using wireless technology or by means of wired connection), and including at least one processor (e.g., a remote server, a PC, a laptop, a tablet, etc.) running a computing algorithm for processing the obtained digital data, i.e., for performing a first calculation of the number of persons 1 present in the mentioned specific area of interest Z. The value resulting from said first calculation is transmitted, also through any connection using wireless technology or wired technology, to the at least one control unit (not illustrated) of the ski lift 10 dynamically modulating the operative conditions thereof depending on the mentioned result, for example, increasing and/or reducing, within a certain range/percentage, the speed of the ski lift 10, without stopping it, except when the mentioned first calculation indicates the absence of persons 1 in the specific area of interest Z, for example, during a prefixed time period.

[0021] In one embodiment, the percentage of variation of the speed of the ski lift 10 is done by means of a 4-20 mA analog signal acting as an input signal of the control unit of the ski lift 10. It is alternatively performed by means of a computer dialogue through a connection with a regulation and/or measurement device (not illustrated) of the ski lift 10.

[0022] For example, when the value resulting from said first calculation indicates that there is a small number of persons 1 present in the specific area of interest Z (for example below a pre-established threshold value), the control unit of the ski lift 10 will automatically reduce the speed to a minimum value the ski lift can tolerate (e.g., 3 m/s). The system therefore allows significantly reducing the power consumption of the ski lift 10 and the energy efficiency of the system is therefore optimized, maintaining its performances, by allowing transporting the number of persons 1 waiting for the ski lift.

[0023] In addition, when the value resulting from the first calculation indicates that there is a large number of persons 1 present in the specific area of interest Z (for example above a pre-established threshold value), the control unit of the ski lift 10 will automatically increase the speed to a maximum value the ski lift can tolerate (e.g., 5 m/s). The system therefore allows increasing the satisfaction of the persons 1 by reducing the waiting times in the specific area of interest Z.

[0024] According to this embodiment, the ski lift 10 can comprise any of a chairlift system, gondola lift system, or drag lift system.

[0025] Fig. 2 shows a second embodiment of the present invention. In this case, unlike the previous embodiment, the system comprises a set of thermal cameras 11 and the means of transport 10 is a monorail. The system includes the thermal cameras necessary for covering; altogether, the mentioned specific area of interest Z. The digital data obtained by each of the thermal cameras 10 are transmitted to the mentioned computing unit 12, and once this computing unit 12 has performed the

mentioned first calculation of the number of persons 1 present in the specific area of interest Z at a specific moment and throughout a time period, this resulting value is transmitted to the at least one control unit (also not illustrated) of the monorail 10, such that the control unit of the monorail 10 can adapt, i.e., change or modify, the number of units (carriages/cars) forming the monorail depending on the resulting value received.

[0026] Instead of adapting the transport units forming the monorail 10, the control unit of the monorail 10 could alternatively adapt the frequency thereof. The control unit of the monorail 10 could even adapt both the units forming the monorail and its frequency.

[0027] In other not illustrated embodiments, the information acquisition means 11 is formed by a visible-spectrum digital camera with a definition having a pixel size sufficient for detecting the persons 1 in the specific area of interest Z, or waiting area, but not sufficient for identifying them.

[0028] Similarly, the information acquisition means 11 can be a turnstile (or turnstile system) located in an area prior to the specific area of interest Z, or waiting area, where the persons 1 are present.

[0029] The flow chart of Fig. 3 shows a preferred embodiment of a method 300 for controlling the operative conditions of a means of transport 10 (ski lift, monorail, tramway, etc.) in which information relating to the persons 1 (without revealing their identity) waiting in a specific area of interest Z close to the mentioned means of transport 10 is obtained (step 301) by means of using at least one information acquisition means 11 formed by a thermal camera. The information obtained (step 302) by the thermal camera is provided in the form of digital data comprising one or more images in the infrared spectrum to a computing unit 12 with one or more processors, and running a computing algorithm for performing a first calculation of the number of persons present in the specific area of interest Z. Finally (step 304) the operative conditions (speed, frequency, number of transport units, etc.) of the means of transport 10 are dynamically controlled or modulated depending on the value resulting from the first calculation, as indicated above, suitably interacting with said means of transport.

[0030] In a preferred embodiment, the mentioned first calculation also includes calculating the waiting time of the persons 1 in the specific area of interest Z. Possible overlapping of the persons 1 in the obtained image/images will preferably be taken into account for calculating the waiting time. Likewise, the calculated waiting time can also be shown to the mentioned persons 1 by means of display screens/panels located in the ski station itself and/or by means of using a computer application installed in a portable computing device, for example, a smartphone.

[0031] Similarly, the dynamic modulation can be performed taking into consideration, also, a second calculation based on a transport optimization index of the means of transport 10, calculated from the first calcula-

tion. The dynamic modulation can be performed by weighing different criteria, the weights of which are parameterizable by a user/operator of the means of transport 10, for example, for achieving the best compromise between the waiting time in the specific area of interest Z and the power consumption of the means of transport 10 or due to the need to introduce a maximum speed or more carriages/cars minutes before closure of the means of transport 10.

[0032] In the mentioned preferred embodiment of Fig. 3, the processing of the image or images in the infrared spectrum is performed in real time. Nevertheless, alternatively, the processing can be performed offline after the image or images in the infrared spectrum has/have been stored in a memory of the computing unit 12, for example.

[0033] The scope of the present invention is defined in the attached claims.

Claims

1. A system for controlling the operative conditions of a means of transport, which comprises:

- at least one information acquisition means (11) suitable and configured for obtaining digital data with information relating to the number of persons (1) present in a specific area of interest (Z) close to at least one access to the means of transport (10), without revealing the identity of said persons (1);
- a computing unit (12) in connection with said information acquisition means (11) and including at least one processor running a computing algorithm for processing said obtained digital data, wherein said processing includes at least a first calculation of the number of persons (1) present in said specific area of interest (Z); and
- a control unit of said means of transport (10) in connection with said computing unit (12) suitable and configured for dynamically modulating the operative conditions of the means of transport (10) including variation of at least its speed, or adaptation of the number of transport units forming it, or its frequency according to at least one value resulting from said first calculation, which is fed by means of said connection to said control unit.

2. The system according to claim 1, **characterized in that** said control unit is connected to a regulation and/or measurement device for regulating and/or measuring the speed conditions, or the number of transport units, or the frequency of the means of transport (10).

3. The system according to claim 1, wherein the infor-

mation acquisition means (11) is a thermal camera covering said specific area of interest (Z), or waiting area, and the obtained digital data is at least one image in the infrared spectrum encompassing the specific area of interest (Z).

4. The system according to claim 1, wherein the information acquisition means (11) is a visible-spectrum digital camera covering said specific area of interest (Z), or waiting area, and the obtained digital data is at least one image encompassing the specific area of interest (Z).

5. The system according to claim 1, wherein the information acquisition means (11) is a turnstile located in an area prior to said specific area of interest (Z), or waiting area, through which the persons (1) access the specific area of interest (Z).

6. The system according to any one of the preceding claims, wherein the means of transport (10) is a means of transport operating in a closed circuit.

7. The system according to claim 6, wherein the means of transport (10) is a ski lift comprising at least one chairlift, gondola lift or drag lift.

8. The system according to claim 6, wherein the means of transport (10) comprises at least one monorail.

9. A method for controlling the operative conditions of a means of transport, comprising:

- a) obtaining, by means of at least one information acquisition means (11), information relating to the number of persons (1) present in a specific area of interest (Z) close to at least one access to the means of transport (10), without revealing the identity of said persons (1), and providing said information in the form of digital data;
- b) processing, by means of a computing unit (12), with at least one processor running a computing algorithm in connection with the information acquisition means (11), said obtained digital data, wherein said processing includes at least a first calculation of the number of persons (1) present in said area of interest (Z) close to said at least one access to the means of transport (10), and
- c) dynamically modulating, by means of a control unit of said means of transport (10) in connection with said computing unit (12), the operative conditions of the means of transport (10) including variation of at least its speed or adaptation of the number of transport units forming it or its frequency according to at least one value resulting from said first calculation.

10. The method according to claim 9, wherein the first calculation further comprises calculating the waiting time of said persons (1) in the specific area of interest (Z). 5
11. The method according to claim 10, **characterized in that** said step c) is performed taking into consideration, in addition, a second calculation based on a transport optimization index of the means of transport (10), parameterizable by a user and calculated from said first calculation, wherein said optimization index is calculated taking into consideration at least one of the following criteria: better compromise between the waiting time and the power consumption of the means of transport (10), availability of the number of transport units in a specific time period, or introduction of a maximum speed in the means of transport (10) minutes before closure thereof. 10 15
12. The method according to claim 9 or 10, wherein the processing of the obtained digital data is performed in real time simultaneously with the reception of the digital data obtained from step a). 20
13. The method according to claim 9 or 10, wherein the processing of the obtained digital data is performed after the digital data has been received and stored in at least one memory of the computing unit (12). 25
14. The method according to claim 10, wherein the dynamic modulation of the operative conditions of the means of transport (10) comprises increasing or reducing, within a range, the speed of the means of transport (10) proportionally to the variation of the calculated waiting time. 30 35
15. The method according to claim 9 or 10, wherein the dynamic modulation of the operative conditions of the means of transport (10) comprises a computer dialogue through a connection with a regulation and/or measurement device for regulating and/or measuring the speed conditions, number of transport units or frequency of the means of transport (10).. 40 45

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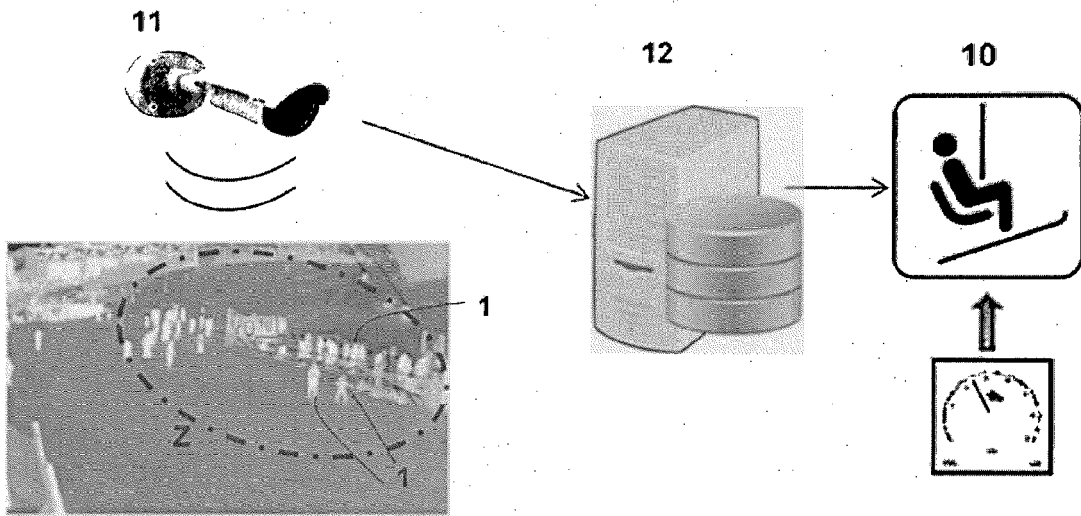


Fig. 1

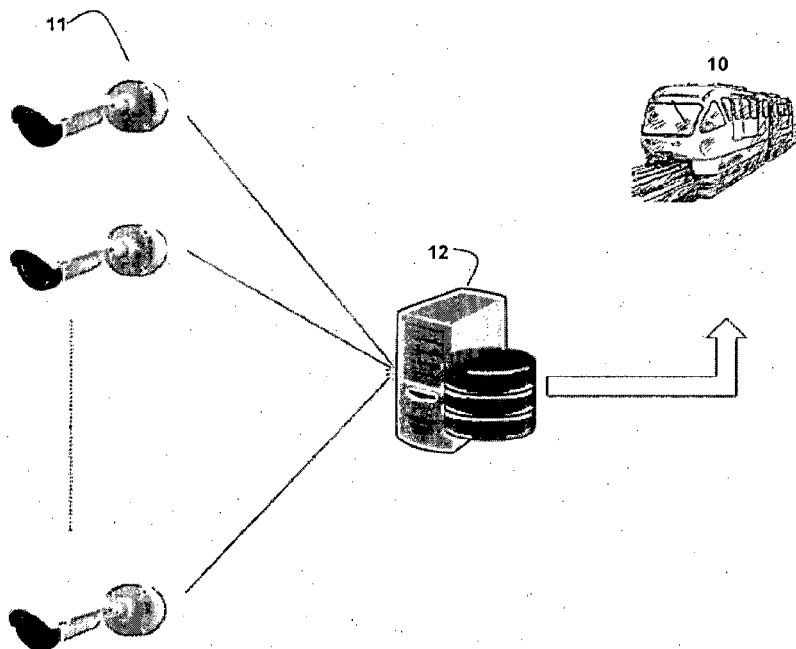


Fig. 2

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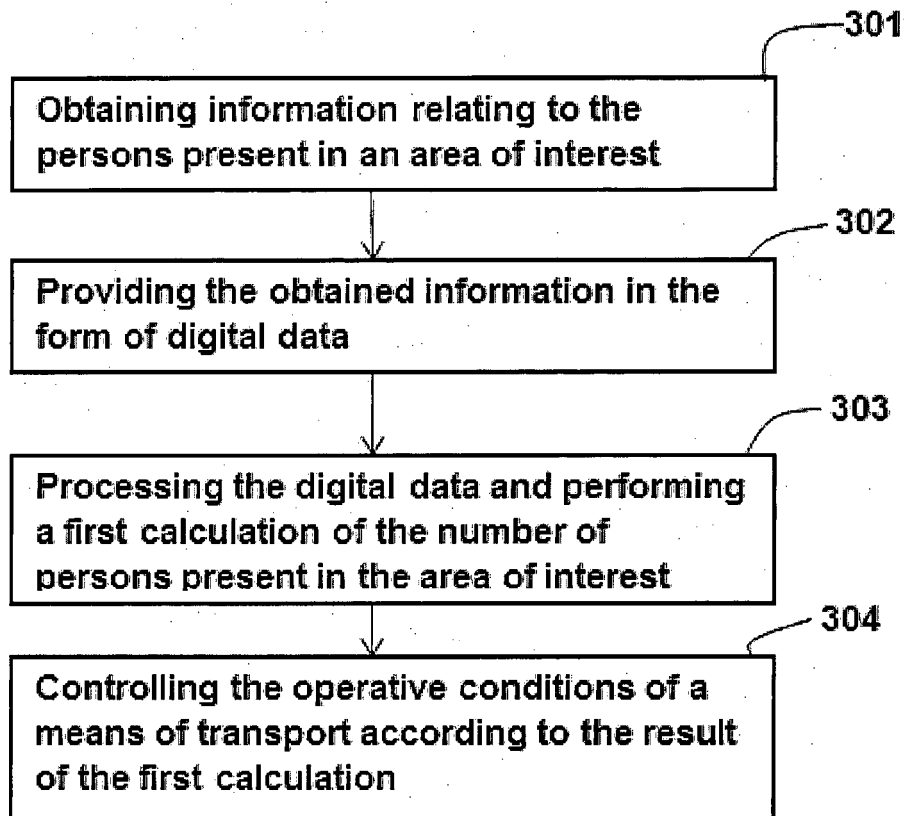


Fig. 3



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Application Number
EP 15 38 0020

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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 3 November 2015	Examiner Bohn, Patrice
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	

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

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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
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