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(71) Applicants:
• **Siemens S.A.S.**
93200 St. Denis (FR)
• **Siemens Aktiengesellschaft**
80333 München (DE)

(72) Inventors:
• **Forni, Virginie**
92120 Montrouge (FR)
• **Gimenez, Jean-Marie**
92100 Boulogne Billancourt (FR)
• **Rahn, Karsten**
38162 Cremlingen (DE)

(74) Representative: **Fischer, Michael**
Siemens AG
Postfach 22 16 34
80506 München (DE)

(54) **Method and system for managing a flow of passengers on a platform**

(57) The present invention proposes a method and a system for managing a flow of passengers at a platform (1), the system comprising:
- a detector capable of counting a number of passengers

waiting at the platform (1);
- a supervision system (3) capable of adjusting a real serving frequency and a real dwell time of the incoming public transports (11) in function of the number of passengers.

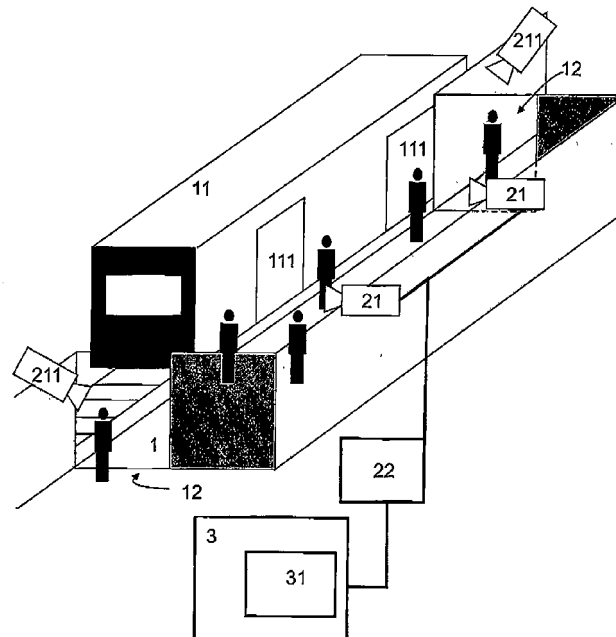


FIG 1

Description

[0001] The present invention concerns a method and a system for managing a flow of passenger on a platform, in particular in the field of public transport, according to claims 1 and 11.

[0002] The present invention relates generally to changes of the number of passengers waiting for a public transport and the management of these changes of number of passengers, in particular to avoid overcrowded platforms.

[0003] A current problem related to public transport is the abrupt changes of the number of people waiting for a public transport, notably during rush hours or in case of a non predictable event. There is actually no method or system capable of managing in real time these changes of the number of passengers waiting for public transports, and as it is well known by people skilled in the art, overcrowded platforms are potential sources for risk security.

[0004] Consequently, there is a standing need for improving the management of the flow of passenger at platforms. It is therefore an objective of the present invention to provide a method and a system for managing in real time a flow of passenger on a platform.

[0005] This objective is achieved according to the present invention with respect to the method by a method for managing a flow of passengers at a platform, the method comprising the steps of:

- determining in real time a number of passengers waiting at the platform in function of the time;
- automatically adjusting a real serving frequency and a real dwell time of incoming public transports at said platform in function of said number of passengers.

[0006] This objective is achieved according to the present invention with respect to the system by a system for managing a flow of passengers at a platform, the system comprising:

- a detector capable of counting a number of passengers waiting at a platform;
- a supervision system capable of adjusting a real serving frequency and a real dwell time of the incoming public transports at said platform in function of said number of passengers.

[0007] The present invention is thus capable of adapting in real time a flow of public transports arrivals and departures at a platform to changes of a number of passengers waiting for said public transport at said platform. In other words, the transport capacity of a public transport network might be adapted in real time to local variations on said network of a number of passengers waiting for a public transport of said public transport network and planning to travel with said public transport on said public transport network. By "passenger" we refer to a person

who has the intention to travel with said public transport, and is thus waiting, e.g. on a platform at a station or on a special place dedicated to the waiting, for said public transport. Preferentially, the public transport according to the present invention may comprise several units. Each unit may in particular be coupled at each of its extremities to another unit. For example, such a public transport is a train, and said units are coaches designed for transporting passengers.

[0008] In particular, the step of automatically adjusting the real serving frequency and the real dwell time comprises:

- automatically calculating a theoretical serving frequency and a theoretical dwell time for the incoming public transports at said platform in function of said number of passengers and of a transport capacity of said public transport, i.e. calculating a theoretical incoming frequency of incoming public transport serving said platform and a theoretical dwell time for each incoming public transport separating its time of arrival from its departure time, in order to avoid an overcrowded platform; and
- automatically adjusting the real serving frequency and the real dwell time of incoming public transports at said platform to said number of passengers to the theoretical serving frequency and dwell time that have been calculated.

[0009] Indeed, the supervision system may in particular comprise a controller capable of determining a theoretical serving frequency and a theoretical dwell time of incoming public transports at said platform in function of said number of passengers and of a capacity transport of said public transport. In particular, the theoretical serving frequency is proportionally correlated to the number of passengers waiting at the platform. The supervision system is then in particular capable of adjusting the real serving frequency and the real dwell time of the incoming public transports at said platform to the theoretical serving frequency and theoretical dwell time that have been calculated by its controller.

[0010] The theoretical, respectively real, serving frequency refers to a theoretical, respectively real, number of public transports arriving at and then departing from the platform by units of time, the time of arrival and the time of departure being separated by said dwell time. The supervision system is for example an ATS (Automatic Train Supervision System) that is able to manage public transport traffic.

[0011] Preferentially, said detector according to the present invention is capable of counting in real time the number of passengers accessing said platform. Said number might be the exact number of passengers waiting at said platform, or an estimate of the exact number of passengers waiting at said platform. For example, it is able to count a number of passengers crossing a platform access door (for entering the platform area or leaving it),

said access door being the single access to the platform. In this case, the difference between the number of passengers crossing the platform access door for entering and leaving the platform corresponds to the exact number of passengers waiting for the public transport at said platform accessible via said access door.

[0012] In particular, said detector comprises a camera system capable of imaging said platform or at least a part of the platform, e.g. each access door of said platform, by means of at least one camera. The camera of the camera system may be a visible light camera and/or an infrared camera, which advantageously allows to differentiate cold objects from warm objects (e.g. passengers). In particular, said camera system is realized according to a first design which enables said camera system to image the whole surface of said platform, and/or a second design which enables said camera system to image each access door of said platform, by means of one or several cameras. By imaging the whole surface of the platform, and/or each access door, it is advantageously possible to count the number of passengers that are going to travel by said public transport serving the platform, as well as to recognize a passenger needing a special dwell time. For this purpose, the detector comprises in particular an image treatment unit that is capable of counting passengers in an image taken by said camera system, preferentially in each image taken by said camera system. Furthermore, said image treatment unit is preferentially also capable of detecting or recognizing in an image taken by said camera system a passenger having a disability or unconventional behavior. In other words, said image treatment unit is capable of analyzing each image taken by said camera system, and from each image, to determine the number of passengers appearing in the image, and preferentially, if a passenger has a disability or a special behavior.

[0013] Preferentially, said camera system comprises also at least one camera designed for imaging an entrance door of the public transport. In particular, each entrance door of the public transport might be imaged by at least one camera of said camera system. For example, said camera system may comprise at least one on board camera that is mountable at a fixed position in said public transport and designed for imaging an entrance door of said public transport, and/or a platform camera at a position from which it is capable of imaging said entrance door from the platform. By imaging an entrance door of the public transport, the detector is capable to detect a passenger having a problem for jumping into said public transport or a behavior that needs to be communicated to a control center which may command a personal intervention.

[0014] Indeed, the image treatment unit comprises in particular a passengers counting algorithm for determining the number of passengers in an image, and preferentially a profiling algorithm. Said passengers counting algorithm is in particular capable of facial recognition and/or person recognition. The techniques at the basis

of the algorithm of the present invention might be for example background plane subtraction and/or boosting techniques. By means of the profiling algorithm, the image treatment unit is in particular capable of profiling the passengers, which allows a classification of the passengers, notably into three profiles: normal passenger, passenger having a disability, suspect passenger (passenger having a behavior susceptible to result in a personal intervention). The profiling algorithm is preferentially capable of determining the behavior of a person on the platform, for example if said person is waiting for the public transport, or wants to enter into the public transport, or is blocking a door. Preferentially, the image treatment unit is also capable of fusing an image taken by an IR camera with an image taken by a visible light camera in order to enhance the detection of passengers on the platform.

[0015] Preferentially, said passenger counting algorithm is capable of calculating an estimate of the number of passengers occupying the platform from a calculation of a platform surface availability, i.e. an estimation of the surface of the platform that is still available for the passengers (i.e. not occupied by passengers). For this purpose, the surface of the platform might in particular have a special painting or feature that facilitates the estimate of passengers occupying said platform.

[0016] The detector is in particular capable to communicate to the supervision system, notably to its controller and by means of a wire or wireless connection of said detector with said supervision system, a data comprising the number of passengers that has been previously determined by the detector, and preferentially a time stamp (i.e. a date) specifying at what time this number of passengers has been determined by the detector. Said time stamp may be provided by an internal clock of the detector, or an external clock. Preferentially, the detector is also capable of signaling to the controller a presence of a passenger having a disability or a suspect passenger, e.g. who has a special behavior (for example, passengers blocking a door of the public transport), so that said supervision system, notably its controller, may calculate a theoretical dwell time adapted to the disability of said passenger having the disability, or respectively signal to the control center said special behavior. Advantageously, the present invention allows thus to automatically adapt the dwell time of the public transport to a disability of a passenger, in particular by increasing the dwell time if at least one passenger who is going to travel by said public transport is susceptible of having a disability, e.g. a problem for jumping in said public transport. Advantageously, for an on site quick intervention, the supervision system, notably its controller, or the image treatment unit, may be directly connected to a voice-based notification system of the platform and/or of the public transport for automatically giving notification to passengers (e.g. if passengers are blocking doors). The present invention allows thus targeted instructions to be notified to passengers at doors of the public transport or at the platform,

and a targeted management of the dwell time depending on results of the profiling algorithm.

[0017] Said number of passengers waiting for the public transport, and in particular said time stamp, are preferentially used by as input parameters by the supervision system, notably by its controller, for adjusting said real serving frequency and real dwell time. In particular, if the number of passengers per unit of time overcomes a threshold value at a platform, each platform being in particular characterized by its own threshold value, then said supervision system is able to manage the public transport traffic for increasing the frequency of the public transports at said platform. The public transport traffic management is in particular done in function of a number of running public transports and their associated dwell time, and running speeds. Preferentially, in order to increase a real serving frequency, the supervision system is able to modify an upstream traffic of public transport by reducing dwell times of coming public transports in upstream stations and/or increasing the running speed of coming public transports, while respecting security parameters such as inter public transport distance, speed limits, etc. Preferentially, if a platform overcrowdedness overcomes a limit value, or if the threshold value of several platforms is overcome, then the supervision system according to the invention is able to inject at least one additional public transport unit in the traffic.

[0018] Preferentially, the controller is able to use said number of passengers waiting for the public transport, and in particular said time stamp, as input parameters for calculating the theoretical serving frequency and the theoretical dwell time of incoming public transports at the platform. Preferentially, the controller is capable of quantifying the overcrowdedness of the platform in function of time, wherein said overcrowdedness might be defined as the ratio of the number of passengers counted by the detector in function of time over a platform passenger capacity. In particular, from said time stamp, the controller is also capable of calculating a short time trend of an evolution of the number of passengers in function of time in order to predict an increase or decrease of the real serving frequency of the public transports at the platform. Preferentially, the supervision system comprises a database and is capable of storing in said database said number of passengers in function of time and of making probabilistic calculation, notably by means of its controller, of the number of passengers in function of time from the stored numbers of passengers in function of time, notably to make long time trends, which may serve for example to determine a rush hour number of passengers. In particular, the controller determines said theoretical serving frequency and said theoretical dwell time only if the overcrowdedness exceeds the threshold value (e.g. when the ratio of the number of passengers counted by the detector over the platform passenger capacity equals 0.7), and if the trend predicts an increase of the number of passengers in function of time. Said number of passengers might be thus used for triggering the adaptation

of the real serving frequency and the real dwell time by the supervision system.

[0019] Preferentially, the supervision system is capable of adjusting the real serving frequency of the incoming public transports at said platform, and the real dwell time of said incoming public transports, to the theoretical serving frequency and theoretical dwell time, for example by speeding up public transports on the public transport network and/or by decreasing the dwell time at other platforms and/or at said platform and/or by injecting at least another public transport unit in said public transport network.

[0020] The invention will now be described in a preferred but not exclusive embodiment with reference to the accompanying drawing, wherein:

Figure 1 is a schematic illustration of one embodiment of the system according to the invention;

[0021] Figure 1 shows a schematic illustration of one embodiment of a system for managing a flow of passengers at a platform 1, the system comprising:

- a detector capable of counting a number of passengers waiting at the platform 1, said detector comprising in particular a camera system comprising itself at least one camera 21 and an image treatment unit 22;
- a supervision system 3 capable of adjusting a real serving frequency and a real dwell time of an incoming public transport 11 at said platform 1 to said number of passengers, wherein said supervision system 3 may be connected to said detector, in particular to the image treatment unit 22, so that the image treatment unit 22 is able to communicate to the supervision system 3 the number of passengers and a time stamp as input parameters. Preferentially, the supervision system 3 comprises a controller 31 capable of determining a theoretical serving frequency and a theoretical dwell time of incoming public transports 11 at said platform 1 in function of said number of passengers and of a capacity transport of said public transport 11. The supervision system 3 is in particular capable of adjusting a real serving frequency and a real dwell time of the incoming public transports 11 to the theoretical serving frequency and theoretical dwell time that have been calculated by said controller 31.

[0022] The supervision system 3 is in particular capable of directly communicating with and commanding the public transport 11, for example via a wireless communication.

[0023] Preferentially, the cameras 21 are able to image the platform 1 and/or each door entrance 111 of the public transport 11. In particular, other cameras 211 may each image a platform entrance door 12, wherein the platform entrance doors 12 are the only way to access said plat-

form 1. Other counting systems or techniques might be used by a person skilled in the art for counting a number of people entering or leaving a platform area, like for example techniques based on a tickets counter, or a turnstile.

[0024] The images taken by the cameras 21, 211 are then analyzed in real time by the image treatment unit 22, which is able, by means of a passengers counting algorithm to determine the number of passengers in each image. Said passengers counting algorithm is for example capable of counting in function of the time the number of passengers passing each platform access door 12 for entering and/or leaving the area of the platform 1. In particular, from the difference of passengers passing the platform access door 12 for leaving and for entering the area of the platform 1, the image treatment unit 22 is able to determine in real time the platform occupancy, i.e. the number of passengers waiting at said platform 1. In particular, the platform occupancy at a time t equals the number of passengers having entered the area of the platform until time t minus the number of passengers having left said area until time t , wherein a passenger may enter the area either by passing said platform access door 12 (e.g. counted from images taken by said other camera 211) or by deboarding an income public transport (e.g. counted from images taken by said camera 21), and may leave said area by passing the platform access door 12 (e.g. counted from images taken by said other camera 211) or by boarding an income public transport (e.g. counted from images taken by said camera 21). According to a preferential embodiment of the invention, the image treatment unit 22 is able to determine the number of passengers waiting for a public transport 11 directly from images of the platform 1 taken by cameras 21 by means of said passengers counting algorithm in a manner free of any device for counting passengers passing the platform access door 12. Preferentially, said image treatment unit 22 comprises a profiling algorithm capable of recognizing at least three different types or profiles of passengers:

- normal passenger: i.e. passengers having a normal behavior;
- passenger having a disability: i.e. passengers susceptible of having a problem for jumping into the public transport and needing more time or help for jumping into said public transport;
- suspect passenger: passenger having a behavior susceptible to result in a personal intervention, or leading to a risk security, or to damages.

[0025] In particular, the image treatment unit 22 is directly connected to a voice-based notification system of the platform 1 and/or of the public transport 11 for providing predefined notification to passengers, notably in function of an identified profile. Information or data related to the number of passengers is then transmitted by the detector to the supervision system 3. Said information

or data comprises in particular said number of passengers in function of time, and preferentially a time stamp. Said information or data may also comprise a profile data if a passenger having a disability has been detected or if a suspect passenger has been detected.

[0026] The supervision system 3 is then able to adjust a public transport traffic at said platform in function of said number of passengers in function of time. In particular, said supervision system 3 is able to increase the incoming frequency of public transports 11 at a platform 1 if said number of passengers overcomes a threshold value.

[0027] Preferentially, the controller 31 of the supervision system 3 is capable of calculating in real time a theoretical serving frequency and a theoretical dwell time of incoming public transports 11 at said platform 1 from said number of passengers while taking into account the capacity transport of the public transport 11. Preferentially, the supervision system 3 is able to store in a database said number of passengers in function of time, and in particular, the corresponding calculated theoretical serving frequency and theoretical dwell time. Advantageously, said controller 31 might be able of calculating and predicting a probable theoretical serving frequency and a probable theoretical dwell time in function of time from previously stored values of numbers of passengers in function of time stored in said database.

[0028] The supervision system 3 and/or the image treatment unit 22 might be also able to signal to a control center any profile corresponding to the «suspect passenger» profile and/or the «passenger having a disability» profile, so that said control center may decide if a personal intervention on site is necessary. Preferentially, said controller 31 is also able to communicate to said the supervision system 3 a trend characterizing a variation of said theoretical serving frequency, i.e. a prediction of a variation of said theoretical serving frequency in function of time, so that said supervision system 3 may smoothly adapt the serving frequency of the public transport to the theoretical serving frequency.

[0029] The supervision system 3 is in particular capable of commanding in real time a change of the serving frequency of incoming public transport at a platform and the dwell time of said public transport at said platform. It is also capable of increasing or decreasing the serving frequency at a platform in order to reach predicted theoretical serving frequency calculated by its controller 31. For example, different types of rush hours might be stored in a database of the supervision system 3, and for each type of rush hour, a theoretical serving frequency might have been calculated. In this case, the supervision system 3 is capable of increasing the serving frequency of incoming public transports so that at said rush hours, the real serving frequency equals to the theoretical serving frequency.

[0030] To summarize, the method and the system according to the invention present the following advantages:

- they allow to avoid dangerous situation of crowded platforms;
- they regulate the public transport traffic to the number of passengers waiting for said public transport;
- they regulate the dwell time of public transport to the type of passenger, and allow a more efficient boarding and deboarding;
- they adjust the traffic offer of public transport to the real time demand;
- they improve the comfort and security of the passengers by avoiding overcrowded coaches and platforms;
- they are able to automatically adapt in real time the public transport schedule to the number of passengers waiting for said public transport at the platform.

Claims

1. System for managing a flow of passengers at a platform (1), the system comprising:
 - a detector capable of counting a number of passengers waiting at the platform (1);
 - a supervision system (3) capable of adjusting a real serving frequency and a real dwell time of the incoming public transports (11) in function of said number of passengers.
2. System according to claim 1, wherein said detector is capable of counting in real time the number of passengers crossing a platform access door (12) of said platform (1).
3. System according to one of the claims 1 or 2, wherein the detector comprises a camera system capable of imaging at least a part of the platform (1) by means of at least one camera (21, 211).
4. System according to claim 3, wherein the camera system comprises at least one camera (21) designed for imaging an entrance door (111) of the public transport (11).
5. System according to one of the claims 1 to 4, wherein the detector comprises an image treatment unit (22) capable of counting passengers in an image taken by said camera system by means of a passengers counting algorithm.
6. System according to claim 5, wherein the image treatment unit (22) comprises a profiling algorithm for recognizing in said image a passenger having a disability or unconventional behavior.
7. System according to claim 6, wherein the image treatment unit (22) is capable of profiling the passen-

gers according to three profiles: normal passenger, passenger having a disability, suspect passenger.

8. System according to one of the previous claims, wherein the image treatment unit (22) is connected to a voice-based notification system of the platform (1) and/or of the public transport (11).
9. System according to one of the previous claims, wherein the detector is able to communicate to the supervision system (3) a data comprising the number of passengers that has been previously determined and a time stamp.
10. System according to one of the previous claims, wherein the supervision system (3) comprises a database and is capable of storing in said database said number of passengers in function of time and of making a probabilistic calculation of the number of passengers in function of time from data of said database.
11. Method for managing a flow of passengers at a platform (1), the method comprising the steps of:
 - determining in real time a number of passengers waiting at the platform (1) in function of time;
 - automatically adjusting a real serving frequency and a real dwell time of incoming public transports (11) at said platform (1) in function of said number of passengers.
12. Method according to claim 11, wherein determining in real time a number of passengers comprises counting in real time the number of passengers crossing a platform access door (12).
13. Method according to one of the claims 11 or 12, comprising the step of detecting a passenger having a disability or an unconventional behavior by means of a profiling algorithm.
14. Method according to one of the previous claims, **characterized by** increasing the real dwell time if at least one passenger who is going to travel by said public transport (11) is susceptible of having a disability.
15. Method according to one of the previous claims, **characterized by** calculating a theoretical serving frequency and a theoretical dwell time only if an overcrowdedness exceeds a threshold value.

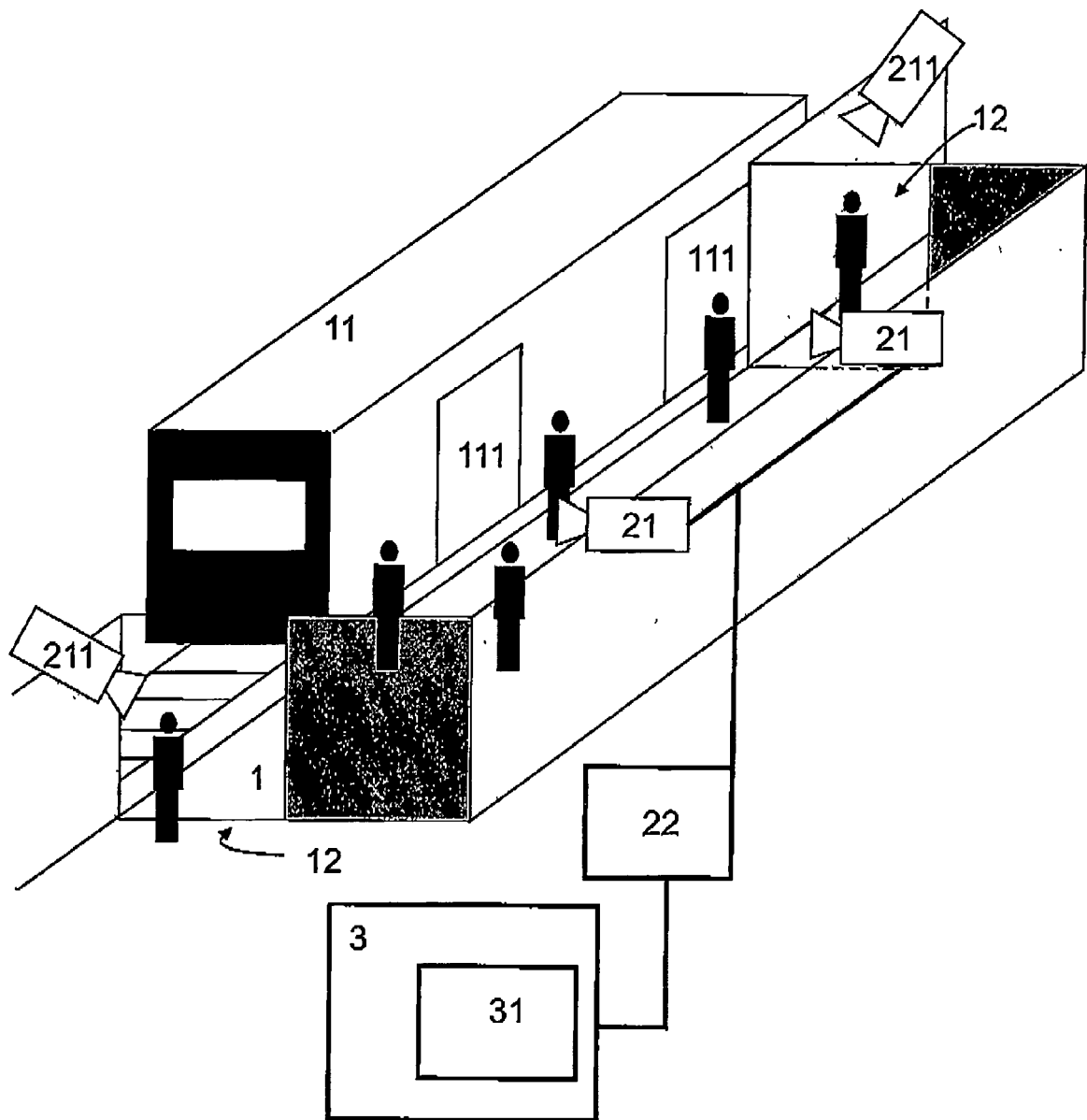


FIG 1



EUROPEAN SEARCH REPORT

Application Number
EP 11 29 0287

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	* paragraph [0006] * * paragraph [0019] - paragraph [0028] * * paragraph [0031] * * paragraph [0089] - paragraph [0090] * * paragraph [0094] * * paragraph [0103] - paragraph [0106] * * paragraph [0128] - paragraph [0172] * * figures *	6,7,13, 14	G08G1/00
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Place of search The Hague		Date of completion of the search 16 November 2011	Examiner Miltgen, Eric
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
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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