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[Continued on next page]

(54) Title: MONITORING METHOD USING A CAMERA SYSTEM WITH AN AREA MOVEMENT DETECTION

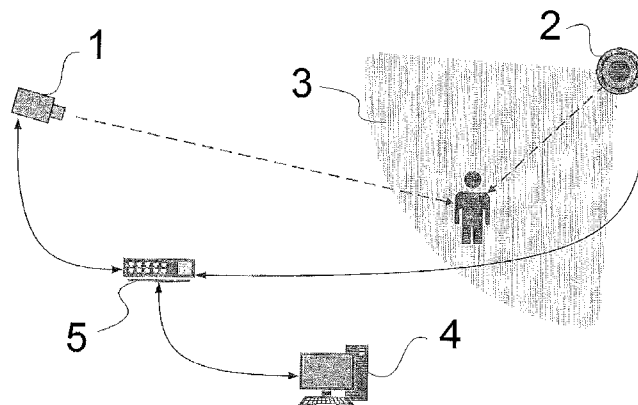


Fig. 1

(57) Abstract: Monitoring method using a camera system with an area movement detection, comprising at least one PTZ camera with a native protocol and with a driver unit for pointing the camera to a point of interest in an area of interest, at least one detector for monitoring of the area of interest, a computer technology provided with a control software intended to create a dimensional coordinate grid of the area of interest on the bases of information gained from the detector about position of single points in the area of interest, where the computer technology is adapted to communicate with the PTZ camera and the detector, and which is further adapted to collect and evaluate the data and the information gained from the PTZ camera and the detector and to automatically set rotation of the PTZ camera with regards to the dimensional coordinates of the area of interest, a switch intended to connect the PTZ camera, the detector and the computer technology provided with the control software, where the detector is a LIDAR detector, whereas the data which transmitted from the detector to the computer technology are in a form of UDP packets, which are comprising information about distance between scanned points and the detector, about a position of scanned points, about calibrated reflection of scanned points, about rotational angle of laser rays sent from the detector and reflected from the scanned points, about synchronised time marks of the laser rays of the detector and about GPS position of the scanned points, where the area of interest is scanned by the detector, the scanned data of the area of interest are send to the computer technology provided with the control software, where the data are processed into the form of a digital model of the area of interest, a minimum size of the object detectable by the detector, which starts further scanning, is defined, a maximum speed of a motion of the object detected by the detector, which starts further scanning,

[Continued on next page]

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is defined, the detector and the PTZ camera are positioned into the position, where monitoring of the area of interest is ensured, calibration of view of the PTZ camera with regards to the scanned digital model of the area of interest is provided by the computer technology, whereas the camera system is set in the such way, that if a movement in the area of interest is detected the PTZ camera is automatically pointed to the area, where the movement was detected, scanning of another predetermined pre-alert zones with low priority is activated, where the moving object is tracked, whereas automatic turn of the PTZ camera into the point of movement in the area of interest is performed, and if in the area of interest a movement is recognized by the PTZ camera alarm is announced.

Monitoring method using a camera system with an area movement detection

Background of the invention

The present invention concerns the monitoring method using a camera system with an area movement detection.

State of the art

A rotational „Pan Tilt Zoom“ camera, in short a PTZ camera, is a camera with possible remote horizontal and vertical rotation and with possible zoom function. The PTZ camera is manually controlled by keyboard or joystick. The PTZ camera is an integral part of supervise security camera systems. Those camera systems ensure to define pre-sets, i.e. user's predetermined positions of view of the camera, which are saved under specific dials. The user is able to bring out the pre-set manually by keyboard or automatically by specific control software, for example invoked by alarm event. Furthermore, the system enables to switch between predetermined positions, i.e. movement of the camera between predetermined positions. However, it doesn't mean movement of the camera into a new occurred point of interest.

Except of manual positioning of the PTZ camera and manual or automatic positioning of the PTZ camera by the pre-sets it is possible to move by the camera totally automatically by „Auto Tracking“, i.e. a hardware built directly in the camera, which is intended to monitor changes of display spots generated by the recorded shot. If any pixels are changed in the range of the shot by movement of an object in the view range of the camera, the camera will concentrate on the changed pixels and will move to catch the moving pixels in to the centre of the camera chip, it means into the centre of the shot picture. The process leads to an automatic movement of the camera. The auto tracking can zoom in or zoom out the shot in order to stabilise size of the group of moving points in the predetermined range in relation to the whole shot of the camera. Because of that the camera is able to zoom into the area of movement without knowledge of precise size of the shot object and knowledge of distance between the object and the camera. When the camera lose the moving object, the camera is moved back into a predetermined position, where it is waiting until further moving pixels will be recognised, than the whole above described process is repeated again.

The auto tracking system concerns only moving pixels in the shot view of the camera, which is only a partial sector of the whole monitored view range of 360° of the PTZ camera. The camera knows nothing about a situation behind it. Because of that the auto tracking system can be abused by person, who entice the camera away by its movement, while the second person can break into the monitored area.

Because of that it is necessary to provide the PTZ camera with a further security monitoring system, which is able to direct the camera into the area of interest.

One solution of this problem is a system with passive infrared detectors. Such system is able to move the camera into the right direction, when the passive infrared detectors detect some movement. However, the system is not able to recognise distance between the object and the sensors, in the other words, it is not able to recognise if the object is close to the sensor or far away from it. Those sensors are not resistant to a bad wind condition, has a short range and reacts also to changes of temperature, for example caused by hot wind. Further disadvantage of the system is a necessity of arrangement of the detectors/sensors at the axes of the PTZ camera, because those systems detects only a direction from which the interruption is coming instead of the exact position of the interruption. The same bad characteristics are reached by use of a further static camera or a thermo camera, which works as a movement detector, in order to navigate the PTZ camera.

A document US20100053330 presents a camera system with movement detection, where a laser system LIDAR is used to collect 3D data, where the data, which are leaving the system, can be used for monitoring of a PTZ camera. The system is usable for movement detection to ensure security in the area of interest. Disadvantage of the presented system is that the system arranges a pivoting camera into the area of disturbance, whereas the camera is at the axes of the LIDAR detector. It is not suspected to connect two coordinate systems, i.e. the coordinate system LIDAR and the coordinate system PTZ, which is necessary for the case of use of the system with a camera arranged out of the axes of the detector, or if the system is connected to more cameras.

The aim of the present invention is to disclose a monitoring method using a camera system with an area movement detection, where above mentioned disadvantages of the state of the art are eliminated.

Feature of the invention

The above mentioned disadvantages are considerably eliminated by a monitoring method using a camera system with an area movement detection, comprising at least one PTZ camera with a native protocol and with a driver unit for pointing the camera to a point of interest in an area of interest, at least one detector for monitoring of the area of interest, a computer technology provided with a control software intended to create a dimensional coordinate grid of the area of interest on the bases of information gained from the detector about position of single points in the area of interest, where the computer technology is adapted to communicate with the PTZ camera and the detector, and which is further adapted to collect and evaluate the data and the information gained from the PTZ camera and the detector and to automatically set rotation of the PTZ camera with regards to the dimensional coordinates of the area of interest, a switch intended to connect the PTZ camera, the detector and the computer technology provided with the control software, where the detector is a LIDAR detector, whereas the data which transmitted from the detector to the computer technology are in a form of UDP packets, which are comprising information about distance between scanned points and the detector, about a position of scanned points, about calibrated reflection of scanned points, about rotational angle of laser rays sent from the detector and reflected from the scanned points, about synchronised time marks of the laser rays of the detector and about GPS position of the scanned points, where the area of interest is scanned by the detector, the scanned data of the area of interest are send to the computer technology provided with the control software, where the data are processed into the form of a digital model of the area of interest, a minimum size of the object detectable by the detector, which starts further scanning, is defined, a maximum speed of a motion of the object detected by the detector, which starts further scanning, is defined, the detector and the PTZ camera are positioned into the position, where monitoring of the area of interest is ensured, calibration of view of the PTZ camera with regards to the scanned digital model of the area of interest is provided by the computer technology, whereas the camera system is set in the such way, that if a movement in the area of interest is detected the PTZ camera is automatically pointed to the area, where the movement was detected, scanning of another predetermined pre-alert zones with low priority is activated, where the moving object is tracked, whereas automatic turn of the PTZ camera into the point of movement in the area of

interest is performed, and if in the area of interest a movement is recognised by the PTZ camera alarm is announced.

Description of the drawing

The invention will be further explained by using the drawing, in which Fig. 1 presents the camera system according to the invention.

Feature of the invention

The camera system according to the invention creates a 3D map by method of remote measuring of distance by calculation of speed of a laser beam pulse reflected from a solid object. Usually a spectrum which is close to infrared spectrum is used. A laser beams are resistant to bad wind conditions such as fog and snowfall. Those are not influenced by changes of temperature, shadows and so on. A user has an opportunity to decide, which area will be monitored, on the bases of the 3D map. The system enables precise definition of an area of interest not only by 2D horizontal map but also by complete 3D map. If a disturbance is detected in the farer distance than is a defined distance of the area, such alert will be repressed.

The system responds only to increased number of moving points. Those points represent moving objects and its precise parameters, i.e. position in the map or GPS coordinates.

Fig. 1 presents the camera system with an area movement detection according to the invention, comprising at least one PTZ camera 1 with a driver intended to direct the camera, at least one individual LIDAR detector 2, which is separated from the PTZ camera, and which monitors an area 3 of interest, and a computer technology 4 with a control software, i.e. a control unit, which communicates with the PTZ camera 1 and the detector 2. The computer technology 4:

- collects data/ information gained by the PTZ camera 1 and the detector 2,
- processes the data and creates a dimensional coordinate grid of the area 3 of interest, and
- automatically defines rotation of the PTZ camera 1 according to coordinates of the point of interest. The point of interest is a point, which is monitored in the common regime or a point, where a movement or any other interruption was occurred.

Both devices, i.e. the PTZ camera 1 and the detector 2, are IP devices connected by network active element, i.e. a switch, to a local computer network LAN to which also the computer technology 4 is connected.

It is possible to move by the detector 2 to get a 3D model of the whole surrounding, and even those places, which will be not monitored. The 3D map is created by points stored at any time. A more precise and detailed 3D grid is possible to be reached by movement of the detector 2. However, such volume of data is difficult to be processed. The data processing is carried out only during initialisation of the system or when objects in the monitored area is replaced by order of a caretaker of the area or automatically on the bases of a script. The performed map is intended for easy orientation of the caretaker in the monitored area. For the detection process a „raw data“ presented in the pre-scanned 3D map are used. Because of visualisation reason the data can be differentiated from the 3D map by colour.

When the PTZ camera 1 is to be target it's position has to be known – i.e. a „zero position“, it means its horizontal and vertical turn measured in degrees, and a value of zoom measured defined by value of a shot angle. However, commonly used PTZ cameras use co called "Pelo D" protocol, which enables precise turning of it. With regards to the camera system according to the invention, it is necessary to turn the PTZ camera 1 by so called a „native“ protocol and a specially configured controller, which means by a protocol issued by producer of the camera system intended to ensure communication between the control software and the PTZ camera 1. Due to that automatic pivoting and zooming of the PTZ camera 1 into a point of interest, on the bases of an order specified by above mentioned values of vertical and horizontal turn and value of zoom, is performed.

The PTZ camera 1 has the zero position set by producer, for example performed by magnetic contact placed in its body.

Advantageously, the PTZ camera 1 can be provided by electronical compass for the reason of calibration. When the camera 1 is installed and initialled, it means when the camera is automatically arranged at the zero position, the needle of the compass is turned into the direction of the camera 1. By that way an information about deviation between pre-set value of the zero position of the PTZ camera 1, a horizontal grid and the needle of the compass is transmitted to the system. The

deviation will be added or subtracted whenever the PTZ camera 1 will be directed to a new desired point of interest.

The second option of synchronisation of the position of the PTZ camera 1 with regards to the 3D map is provided only by software. The PTZ camera 1 can be directed to the point in the 3D map by hand and calibrated to the point in the 3D map with regards to the real position of the PTZ camera 1 after the 3D map is scanned. For better orientation of the operator within the map it is possible to use a targets with a reflective surface. The laser detector 2 returns the reflection reflected from the reflective surface with an indication of a calibrated reflection. Those places can be presented in the 3D map by different colour.

A method of installation and setting of the camera system according to the invention is presented below:

- In the first stage, an area 3 of interest and its surrounding is scanned by a detector 2. A processed outcome of the scanning process is a quantity of points, which can be interpolated into a digital model of a surface or into a 3D model of a building or other objects.
- Afterwards the detector 2 is arranged so as to scan the area 3 of interest.
- Furthermore a pivoting PTZ camera 1 is installed in such way, that its position ensures scanning of the area 3 of interest. It is not necessary to arrange the PTZ camera 1 at the axes of the detector 2.
- Calibration of a view of the PTZ camera 1 with regards to the scanned digital model of the area 3 of interest is performed by the computer technology 4.
- Afterwards, the pivoting PTZ camera 1 are pointed to the point of interest by the computer technology 4 with accuracy +/- 3cm. That setting can be manual, by pointing to the point in the scanned grid, or automatic, invoked when the area is violated by moving object. The system knows an exact position of each moving point and its distance from the detector 2.

Above mentioned steps of the method can be performed in a different order or not performed at all.

It is possible to define more specific zones in the scanned digital model of the area 3 of interest. If movement in those zones is recognised it is possible to respond by action performed by the control system of the computer technology 4, for example

by definition of pre-alert zones, where the system follows the moving object, but where an alarm is not invoked. The alarm is invoked when the object is detected in a zone with higher priority of protection.

A minimum size of a detectable object can be defined in the scanned digital model of the area 3 of interest. Possible definition of minimum size of a detected object depends on a distance between the object and the detector 2, respective on density of the grid.

A maximum speed of a detectable object can be defined in the scanned digital model of the area 3 of interest. It is effective way how to eliminate a false alarm caused by for example a flying bird.

If the detector 2 recognise a movement in the area 3 of interest, the system turns the PTZ camera 1 into the area and activates a system of video detection. Activation of alarm is postponed until existence of the movement in the camera shot is confirmed, or is activated immediately. The impulse for turning the PTZ camera 1 is a signal transmitted from the computer technology 4 by controller.

In the advantageous embodiment parameters of the detector of the camera system according to the invention are defined as follows:

- The detector 2 is a LIDAR detector comprising 16 canals, i.e. laser beams. A system equipped by such detector is able to define a grid with up to 57600 points. 288000 points per second are detected if speed is 5Hz. It is possible to use a detector 2 with 32 or 64 canals, i.e. laser beams, if a brother grid is required.
- Accuracy of detection is +/- 3cm. Accuracy of a multichannel detector is up to +/- 2cm.
- Angle of a shot is in the vertical point of view from +15° to -15° and from horizontal point of view 360°.
- Vertical resolution is 2°. Vertical resolution of a multichannel detector can be up to 0,3°.
- Horizontal resolution is 0,1° to 0,4°. Horizontal resolution of a multichannel detector can be up to 0,09°.
- Pivoting speed is 5 to 20 Hz.
- The laser used in the presented embodiment has length of wave 905 nm, which is defined as a laser of low energy, i.e. the first class of classification. The first class is safe under all conditions. There is no health risk if a person

look accidentally directly into a laser beam, because there is not exceeded a maximal expectable value of radiation, i.e. „MPE“.

- A covering of the detector 2 is IP67.
- Outcome speed of shooting is 0,3 billion points per second.
- The detector 2 sends data to the computer technology 4 in a form of UDP packets comprising information about distance of the scanned points from the detector 2, about position of the scanned points, about calibrated images of shot points, about rotary angle of laser beams dispatched from the detector 2 and reflected from scanned points, and about GPS positions of scanned points.

In the advantageous embodiment the parameters of the PTZ camera 1 of the camera system according to the invention are defined as follows:

- A camera chip of the PTZ camera 1 is CMOS ½.8“ HD ensures better shot function even in bad visibility condition.
- Resolution is advantageously Full HD 1920x1080P.
- Advantageously, there is used an optical zoom with thirty times zoom possibility.
- Horizontal pivoting speed is 240°/s and vertical pivoting speed is 200°/s.

All above mentioned parameters are only advantageous embodiments. Each of the parameters can be used to exclude the others. The camera system according to the invention works with any pivoting PTZ camera even with different parameters.

Example of horizontal distance between single beams of the detector 2, where the angle is 2°, is 10m/35cm, 20m/70cm, 30m/105cm, 40m/140cm, 50m/174cm, 60m/209cm, 70m/244cm, 80m/279cm, 90m/314cm, 100m/349cm.

Example of vertical distance between single beams of the detector 2, when the angle is 0,1°, is 10m/2cm, 20m/3cm, 30m/5cm, 40m/7cm, 50m/9cm, 60m/10cm, 70m/12cm, 80m/14cm, 90m/16cm, 100m/17cm.

If the detector 2 is arranged in height 25m a detective cylinder with diameter 100m and height 51m is created, i.e. with horizontal coverage 360° and a vertical coverage 30°.

Advantage of presented camera system according to the invention is easy and intuitive control, and simplicity of the first calibration.

Density of the horizontal grid between single beams is sufficient also for a long distance. For a distance 60m from the detector 2 is vertical scattering of the beams only 10cm. For maximal distance 100m from the detector 2 is vertical scattering of the beams only 17cm. Because of the above mentioned density of the beams secure detection of persons is ensured even for the maximum distance.

Vertical dispatch of 16 beams ensures detection of persons for a maximum distance 50m, where difference between single scanned layers is 174cm. Two times higher density of the grid is provided by mechanical movement of the whole detector 2, for example vertically by $+1^\circ$ and after that again vertically -1° with speed 5Hz. Advantageously it is possible to use a 32 or 64 laser beam version of the camera system according to the invention with two or four time higher density of the grid.

Because of very easy calibration and an intuitive control software it is possible to use the whole system also as a mobile system. In such case, the pivoting PTZ camera 1 and the detector 2 is equipped by stative, i.e. „tripody“. The pivoting PTZ camera 1 and the detector 2 can be connected wirelessly to a local network LAN. By scanning of a secured area by the detector 2, the operator get an exact map and a 3D model of the secured area. Because of that, difficult upload and calibration of a stationary map is not necessary, as it is known from the mobile systems known from the state of the art.

Claims

1. Monitoring method using a camera system with an area movement detection, comprising:
 - at least one PTZ camera (1) with a native protocol and with a driver unit for pointing the camera to a point of interest in an area of interest,
 - at least one detector for monitoring of the area of interest,
 - a computer technology (4) provided with a control software intended to create a dimensional coordinate grid of the area (3) of interest on the bases of information gained from the detector (2) about position of single points in the area (3) of interest, where the computer technology (4) is adapted to communicate with the PTZ camera (1) and the detector (2), and which is further adapted to collect and evaluate the data and the information gained from the PTZ camera (1) and the detector (2) and to automatically set rotation of the PTZ camera (1) with regards to the dimensional coordinates of the area (3) of interest,
 - a switch (5) intended to connect the PTZ camera (1), the detector (2) and the computer technology (4) provided with the control software, where the detector (2) is a LIDAR detector,
 - whereas the data which transmitted from the detector (2) to the computer technology (4) are in a form of UDP packets, which are comprising information about distance between scanned points and the detector (2), about a position of scanned points, about calibrated reflection of scanned points, about rotational angle of laser rays sent from the detector (2) and reflected from the scanned points, about synchronised time marks of the laser rays of the detector (2) and about GPS position of the scanned points,**characterised in, that**
 - the area (3) of interest is scanned by the detector (2),
 - the scanned data of the area (3) of interest are send to the computer technology (4) provided with the control software, where the data are processed into the form of a digital model of the area (3) of interest,
 - a minimum size of the object detectable by the detector (2), which starts further scanning, is defined,

- a maximum speed of a motion of the object detected by the detector (2), which starts further scanning, is defined,
- the detector (2) and the PTZ camera (1) are positioned into the position, where monitoring of the area (3) of interest is ensured,
- calibration of view of the PTZ camera (1) with regards to the scanned digital model of the area (3) of interest is provided by the computer technology (4),
- whereas the camera system is set in the such way, that if a movement in the area (3) of interest is detected:
 - the PTZ camera (1) is automatically pointed to the area, where the movement was detected,
 - scanning of another predetermined pre-alert zones with low priority is activated, where the moving object is tracked,
 - whereas automatic turn of the PTZ camera (1) into the point of movement in the area (3) of interest is performed,
 - and if in the area (3) of interest a movement is recognised by the PTZ camera (1) alarm is announced.

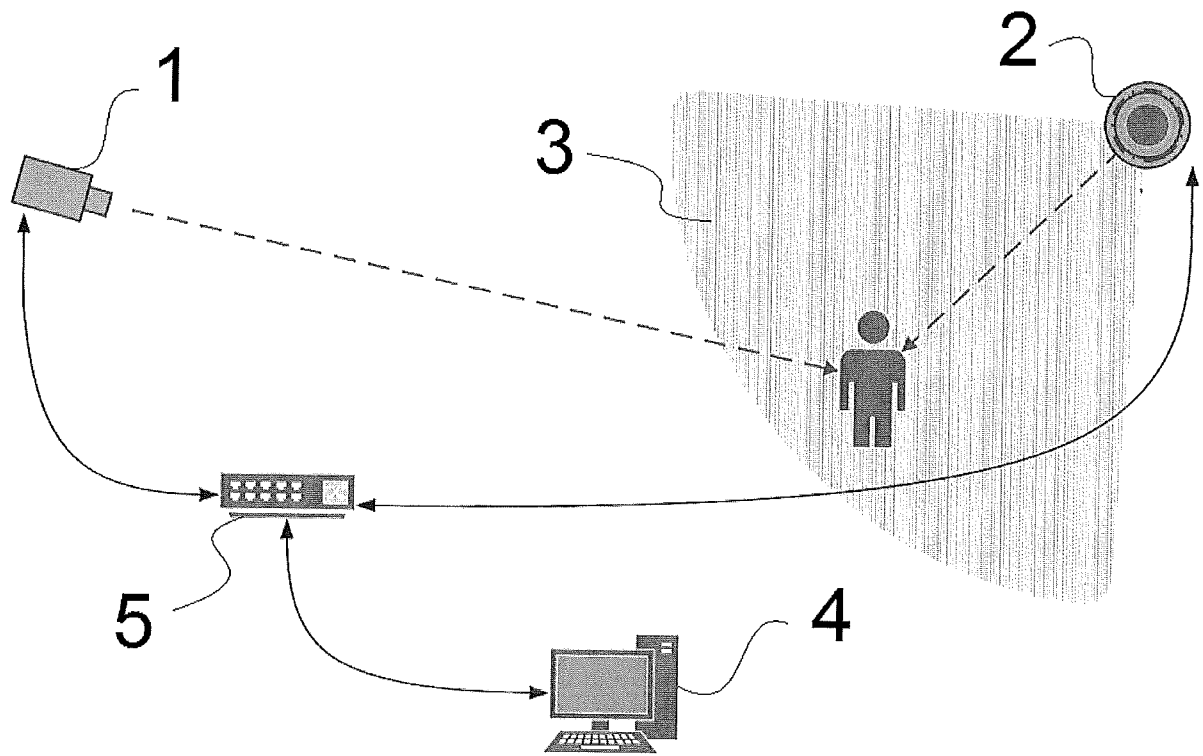


Fig. 1

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
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Minimum documentation searched (classification system followed by classification symbols)
G01S H04N G08B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2010/053330 A1 (HELLICKSON DEAN R [US] ET AL) 4 March 2010 (2010-03-04) cited in the application abstract; figure 9 paragraphs [0019], [0020], [0028], [0036] - [0041] paragraphs [0053] - [0057] paragraphs [0068], [0075] - [0077] -----	1
Y	US 2012/038456 A1 (PIKKARAINEN MARK [US] ET AL) 16 February 2012 (2012-02-16) figure 5 paragraphs [0028], [0029], [0033] ----- -/-	1



Further documents are listed in the continuation of Box C.



See patent family annex.

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Unterberger, Michael

INTERNATIONAL SEARCH REPORT

International application No
PCT/CZ2017/050006

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 2006/028548 A1 (SALIVAR WILLIAM M [US] ET AL) 9 February 2006 (2006-02-09) abstract; figure 1 paragraphs [0046] - [0060] -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

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