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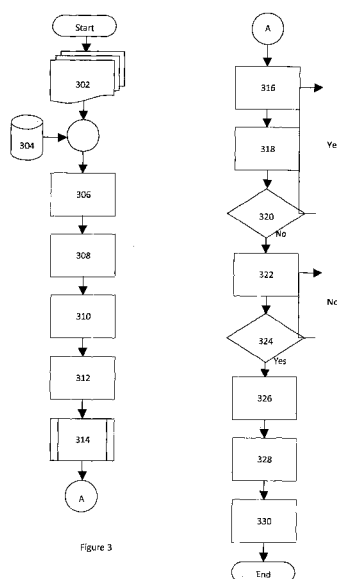
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PI 20092844 7 July 2009 (07.07.2009) MY(71) Applicant (for all designated States except US): **MIMOS
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GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: SURVEILLANCE SYSTEM AND METHOD



(57) Abstract: A surveillance system (100) comprising one or more video camera (102) capturing surveillance scene images of a surveillance area, a control console (108) having a display unit, wherein said control console (108) receives video signal of video images sent by said video camera (102) in order to display said surveillance scene images on said display unit, and a programmed instruction operating on board said control console, wherein said programmed instruction (106) having a first function to define one or more secured zone within said surveillance scene, said secured zone is an enclosed area having curve boundary and a security index, and said programmed instruction (106) computes a response based on said security index when a non-permitted object is within said secured zone.

Published:

— *with international search report (Art. 21(3))*

SURVEILLANCE SYSTEM AND METHOD

FIELD OF INVENTION

The invention relates generally to image processing method and system applicable for video surveillance applications.

5 BACKGROUND OF THE INVENTION

An intelligent video surveillance system can monitor an area under surveillance for any trespass or intrusion into pre- defined security zones. Nevertheless, it tends to be limited in its capacity to function when only single secured zone can be selected
10 for such monitoring purposes. Furthermore by having only a single secure zone, a surveillance system is limited in the responses that it provides when a secured zone is trespassed. Multiple segments that support multiple security levels within a secured zone not only provides more flexibility in having multi-threshold alarm triggering but can also be utilized to optimize the performance of a surveillance
15 system.

It is therefore the objective of the invention to provide a means for multi area selection within an area of interest that is under surveillance.

It is also the objective of the invention to provide segmentation of a secured zone within a surveillance scene and assign security level for each of the secured zones.

20 It is a further objective of the invention to provide multi-threshold triggering within a surveillance scene.

It is a general objective of the invention to solve detection abnormalities encountered in a surveillance application by employing the preferred embodiments of the invention.

SUMMARY OF THE INVENTION

- 5 A system for surveillance comprising one or more video cameras capturing surveillance scene images of a surveillance area, a control console having a display unit, wherein said control console receives video signal of video images sent by said video camera in order to display said surveillance scene images on said display unit, and a programmed instruction operating on board said control console,
- 10 wherein said programmed instruction having a first function to define one or more secured zone within said surveillance scene, said secured zone is an enclosed area within a user-specified boundary and a security index, and said programmed instruction computes a response based on said security index when a non-permitted object is within said secured zone.
- 15 A method for surveillance comprising the steps of acquiring video images, defining one or more secured zones within the surveillance area, segmenting the secured zone into plurality of secured zone segments, assigning security index to each of said secured zone segment

- A method for surveillance further comprising the steps of detecting motion of
- 20 objects, analyzing the movement of each moving object, tracking a non-permitted moving object within the secured zone, retrieving the security index at the location of the non-permitted object, computing a response based on the retrieved security index and triggering a security alert according to said computed response.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram illustrating the invented system for surveillance comprising its major hardware and software components.

Figure 2 is a flow chart illustrating the overall flow for executing steps for
5 surveillance according to the invention.

Figure 3 is a flow chart illustrating a detail flow for executing steps for surveillance according to the invention.

Figures 4A and 4B illustrates a video image display through a display unit of the surveillance system control console and a secured zone defined and superimposed
10 on the same image respectively.

Figure 5 illustrates the screen shot of the graphical user interface of a programmed instruction and its functional tools for executing surveillance according to the steps taught by the invention.

Figures 6A and 6B both illustrate yet another preferred embodiment for defining a
15 secured zone according to the invention.

Figure 7A and 7B respectively illustrate preferred embodiments for creating a secured zone with varying security index or different levels of security index.

DETAILED DESCRIPTION OF THE INVENTION

The invention is a computer vision-based motion detection and object tracking video surveillance system and method that can be applied for intrusion or trespass detection. It performs computer vision-based permitted-objects screening and automatic alarm threshold. The software for executing preferred embodiments of the invention has freeform area selection function in addition to polygonal area selection so that only selected areas would trigger the alarm. Another preferred embodiment of the invention employs means for segmenting a defined secured zone within a surveillance scene and assigning security index to the segments. Assignment of different security levels also gives a more precise control over the surveillance activity to prevent false alarm triggering and allows severity of intrusion to be measured. The following descriptions which apply to all the figures briefly described in the section of the brief description of the invention and not limited only to the particular figure in reference demonstrate these essential features and other salient points of the invention.

Figure 1 illustrates a preferred embodiment of the invention which is a system (100) comprising one or more closed circuit television (CCTV) camera (102), knowledge database (104), a programmed instruction (106) capable of segmenting multiple surveillance area of video images and a control console (108) which can be a purpose built monitoring and control console or a workstation dedicated for this purpose. The CCTV cameras (102) are electrically connected to the control console (108) so that video images captured by it can be displayed through the display unit of the control console. The control console (108) communicates with the knowledge database (104) which can be on or off the site through state of the art networking during the operation of the system. The software (106) which is running on the control console (108) can be an existing video surveillance software upgraded with the multiple surveillance area segmentation function or a new video surveillance software having the function.

The invented surveillance system (100) as illustrated in Figure 1 functions according to the overall process outlined in Figure 2. The system first acquires video images of the surveillance area (202) through the CCTV camera (102) and the images are displayed on the display unit of the control console. Secured zones within the surveillance area that needs to be monitored are identified (204) through the software (106) as to be further disclosed herein. In addition to the identifying the secured zones, the invented system and method are also capable of assigning trigger levels within the secured zone. Following that, the system will monitor the surveillance area (206) according to the identified secured zones and assigned triggering. In the event of any triggering within the secured zones, the surveillance system will initiate and execute defined security actions accordingly (208). After executing the security actions, the system can continue or discontinue monitoring (210) according to predefined rules. The system will either continue monitoring (206) and repeats steps 206 to 210 or stop monitoring the surveillance area (212).

Figure 3 illustrates in further detail the flow for monitoring the surveillance area according to the invention. The monitoring process generally comprises a first section that includes selecting one or more areas of interest i.e. one or more secured zones, segmenting and assigning security index and a second section that includes detecting object, tracking object motion and triggering alarm.

The process for monitoring a surveillance area starts by acquiring video images (302) through the CCTV camera and defining one or more secured zones within the surveillance area. The system communicates with the knowledge base (304) to retrieve information concerning the area under surveillance. The knowledge base stores secured zone information which includes its segments with its security level that may exist for the area under surveillance. Otherwise, defining the secured zone is carried out (306) to set up the surveillance criteria for an area of interest within the surveillance area. Once the secured zone has been identified, the number of segments within the secured zone is also defined (308) and the secured zone is

segmented (310) according the number of defined segments. This is followed by assigning security index (312) to each of the segment. Means and method for defining the secure zone (306), specifying the number of segments within a secure zone (308), defining the segments (310) and assigning the security index of each
5 secure zone segment (312) is further disclosed herein.

Figure 4A and 4B both illustrates the same video images of a possible surveillance scenario which is exemplified by not limited to platform and rail track area in a train station. Figure 4A shows the view of the part of the platform area (402), a rail track area (404) and a train (406) captured by a CCTV camera. Figure 4B shows
10 that the secured zone or area of interest (306a) in this surveillance now includes the no standing area (403) on the platform and the rail track area (404). The selected area is superimposed on top of the surveillance image to facilitate accurate selection of the area of interest.

After carrying out the foregoing steps, the system begins the actual surveillance
15 (314). During surveillance, the system detects motion of objects (316), analyzes the movement of each moving object (318) and determines whether the moving object is an object permitted within the secured zone (320). The system continues to track the movement of the object if the moving object is a non-permitted object (322) and determines position of non-permitted object relative to secured zone (324). The
20 system retrieves the security index of the secured zone (326) when the non-permitted object is within the secured zone. It will compute the response (328) based on the retrieved security index and triggers the security alert (330) according to computed response.

Continuing from the non-limiting example of the train station, the train (406) is an
25 object permitted in the secured zone (306a) while people are objects not permitted within the secured zone.

The means and method for defining the secured zone, the number of secured zone segment and assigning the security index for each of the segment is a programmed instruction operating on the control console (108) providing shape tool functions for drawing areas having polygonal or freeform shape. Figure 5 shows one
5 embodiment of a representation of the graphic user interface (GUI) of the software (501) and its shape tool functions (502) as it appears on the display unit of the control console. The system allows drawing multiple secured zones and its selection via a suitable human interface device such as mouse or trackball. Areas selected will be automatically labelled as 'Unsafe' or labels bearing similar
10 meaning.

Figures 6A and 6B illustrate another preferred embodiment of the method for identifying the area-of-interest using the software means. The software will also have line tools (502) to draw boundary (306b) using lines, curves which can be free-form to define the boundary between 'Safe' and 'Unsafe' area within a
15 surveillance scene. After the boundary is drawn, the user can then specify the 'Unsafe' area (306c) by simply dragging and dropping the 'Unsafe' tag onto the area. The undefined area (306d) will automatically be labelled as 'Safe'.

Figures 7A and 7B illustrates another embodiment of the invention which allows more flexibility in surveillance by another preferred method executed through the
20 software means to provide for secured zones of varying security index. This allows the user to have different responses which cannot be provided when a secured zone has only single homogenous zone of security index.

Figure 7A shows an enclosed area where the security level is reflected by the colour of a location in the secured zone, i.e., a darker colour area in the secured
25 zone has a higher security level than a light colour area in the security zone (or vice versa, depending on the user preference). The enclosed secured zone is filled with varying shades of colour or a single colour with intensity gradient from one

location to another. In this situation, the range of security index is incremented from the starting point (where the area-selection begins) towards the ending point (where the area-selection ends).

Figure 7B illustrates creating secured zone with various security indexes by dividing the 'Unsafe' area (306c) into a number of segments (306c1, 306c2, 306c3, 306c4) for a perimeter-bounded surveillance scene. Each of the segment boundary (702, 704, 706, 708) is a curve composed of many control points connected to one after another which allows the trace of the curve to be further adjusted by adjusting the positions of the control points on the video image. Figure 7B illustrates that perimeter-bounded area usually have segments with increasing security index disposed one after another from the 'Safe' area (306d) towards the 'Unsafe' area (306c). Different levels of the security index are represented by integers 1 to 10 to indicate the severity of deviation (distance deviation) of any 'Unsafe' segments from the 'Safe' area. Each segment's colour intensity is proportional to the value of the Security Index.

After setting up the secured zone, a motion detection module will detect the motion in the surveillance scene. Subsequently, the motion analysis module will analyze the cause of motion, whether it is caused by a permitted object or otherwise. Using the example cited before, the motion analysis module will analyze whether a detected motion is caused by a human or an incoming train. In the train station scenario, only a train is permitted to occupy the area-of-interest. A human, however, is not permitted to trespass the area. Therefore, the motion tracking module will track only human in the scene. The output of the motion tracker is a series of XY-coordinates representing moment to moment positions corresponding to the movement of the object under tracking within the surveillance scene. The position of the object that is being tracked is repeatedly compared to the boundary of the secured zone. If the object's position is on or beyond the boundary of the secured zone, the object is intruding the secure zone. The system will retrieve the

security index corresponding to the position of the object under tracking. Corresponding alarm will be raised after computing the response based on the security index.

It is therefore apparent to anyone skilful in the art as to the practicality and
5 usefulness of such a storage and dispensing system which may also be converted into a storage and disposal system. Therefore, the above description is descriptive and is by no means limitation of the essence of the invention itself in which the scope and embodiment is claimed as below.

CLAIMS

1. A system (100) for surveillance comprising:
one or more video camera (102) capturing surveillance scene images of a surveillance area;
5 a control console (108) having a display unit, wherein said control console (108) receives video signal of video images sent by said video camera (102) in order to display said surveillance scene images on said display unit; and
a programmed instruction (106) operating on board said control console (108), wherein said programmed instruction (106) having a first function to define one
10 or more secured zone within said surveillance scene, said secured zone is an enclosed area having curve boundary and a security index, and said programmed instruction (106) computes a response based on said security index when a non-permitted object is within said secured zone.
2. A system (100) for surveillance as claimed in claim 1, further comprising a
15 second function to define one or more secured zone within said surveillance scene, wherein said secured zone is an enclosed polygonal area.
3. A system (100) for surveillance as claimed in claim 1, further comprising a third function to define one or more secured zone within said surveillance scene by drawing a least one non-connecting boundary from any edge of said surveillance
20 scene images.
4. A system (100) for surveillance as claimed in claim 1, further comprising a fourth function to segmentize said secured zone into plurality of secure zone segments, each said secured zone assigned with its security index

5. A system for surveillance as claimed in claim 1, further comprising a first function to assign said secured zone, wherein security index changes from one end to the other end of the secured zone.
6. A method for surveillance comprising the steps of:
- 5 acquiring video images;
defining one or more secured zones within the surveillance area;
segmenting the secured zone into plurality of secured zone segments; and
assigning security index to each of said secured zone segment.
7. A method for surveillance as claim in claim 6, further comprising the step of
10 retrieving information concerning the area under surveillance, wherein said information includes said secured zone segments with its security level.
8. A method for surveillance as claim in claim 6, further comprising the steps of
detecting motion of objects, analyzing the movement of each moving object,
tracking a non-permitted moving object within the secured zone, retrieving the
15 security index at the location of the non-permitted object, computing a response
based on the retrieved security index and triggering a security alert according to
said computed response.

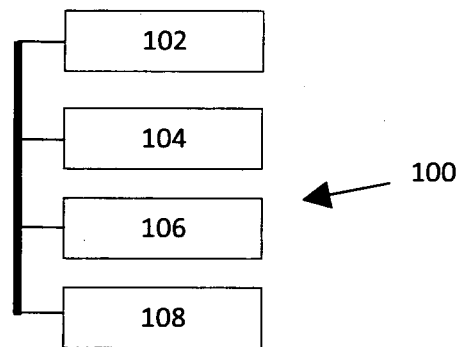


Figure 1

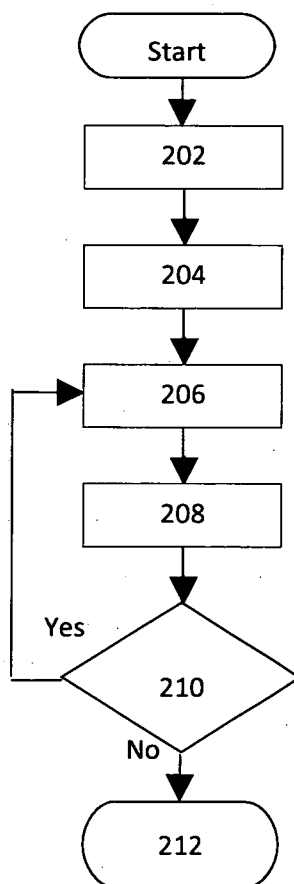
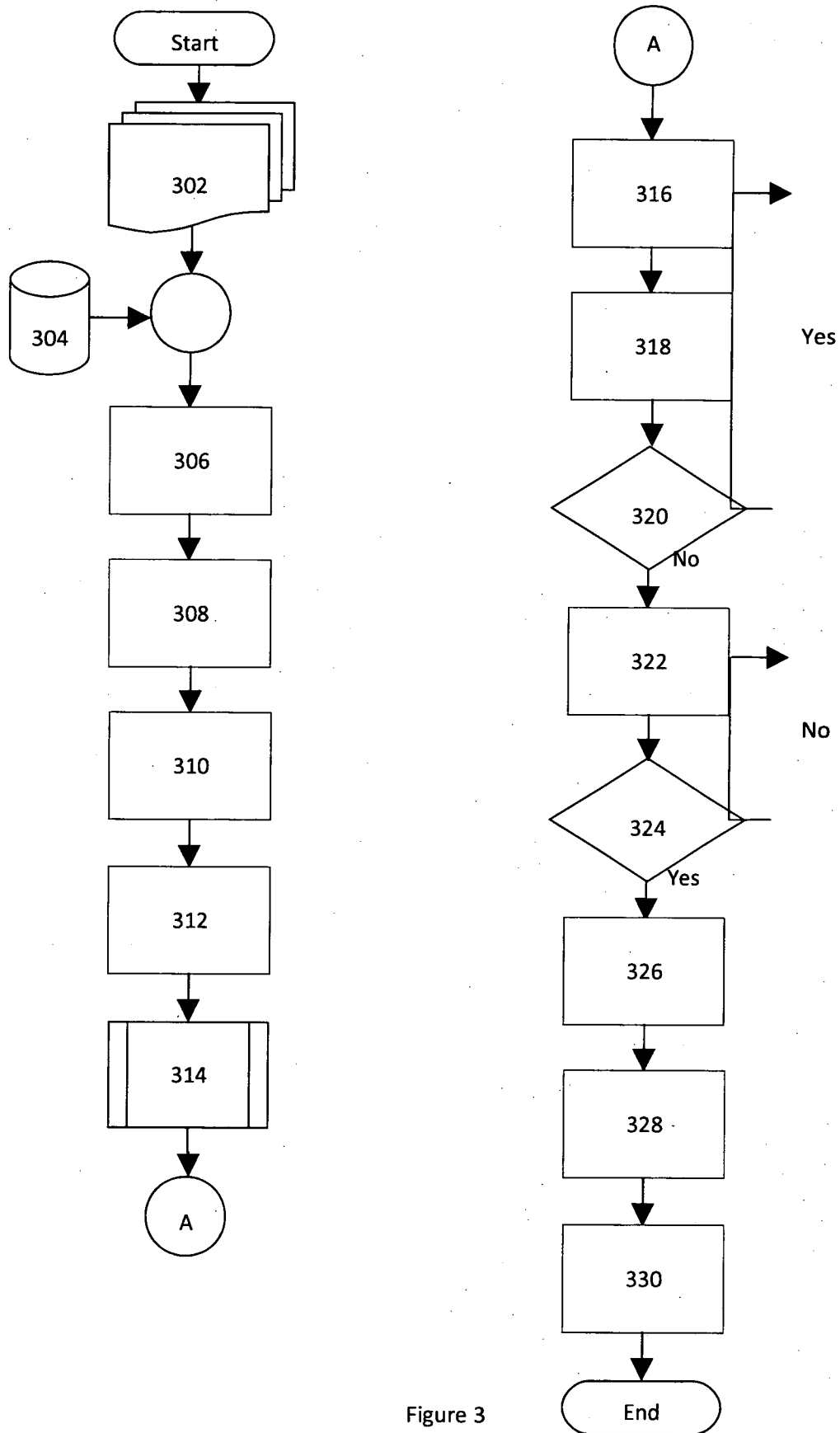


Figure 2



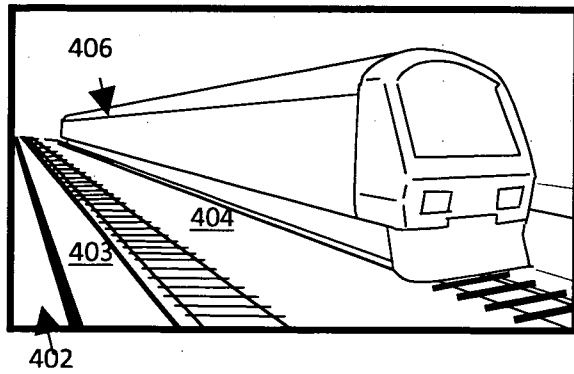


Figure 4A

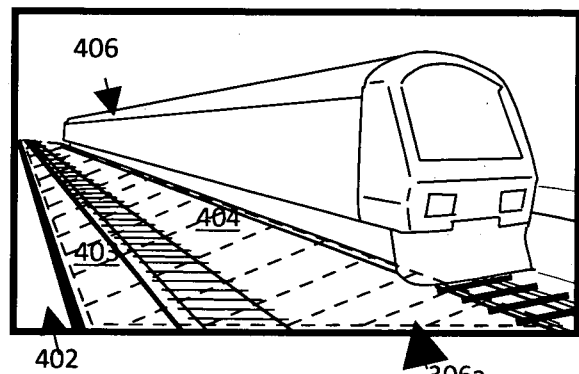


Figure 4B

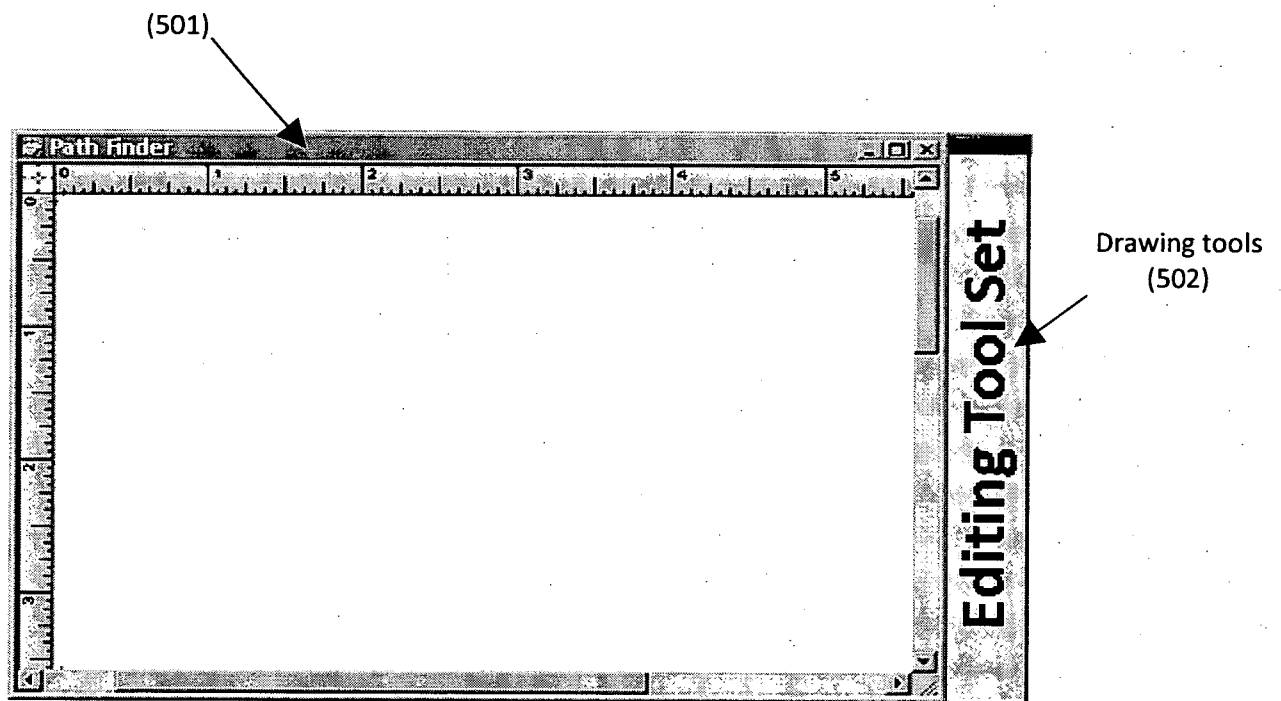


Figure 5

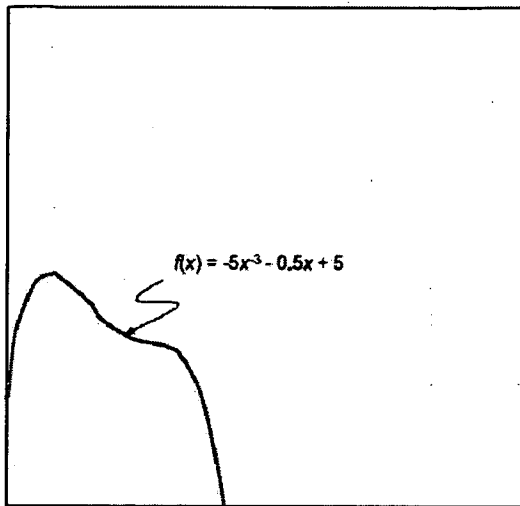


Figure 6A

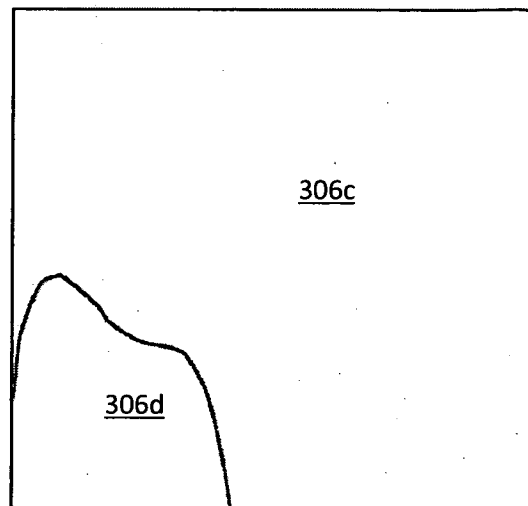


Figure 6B

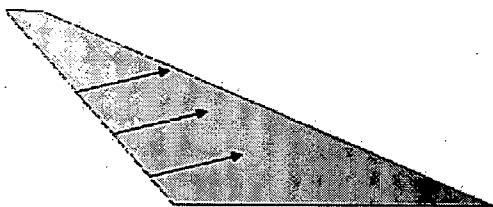


Figure 7A

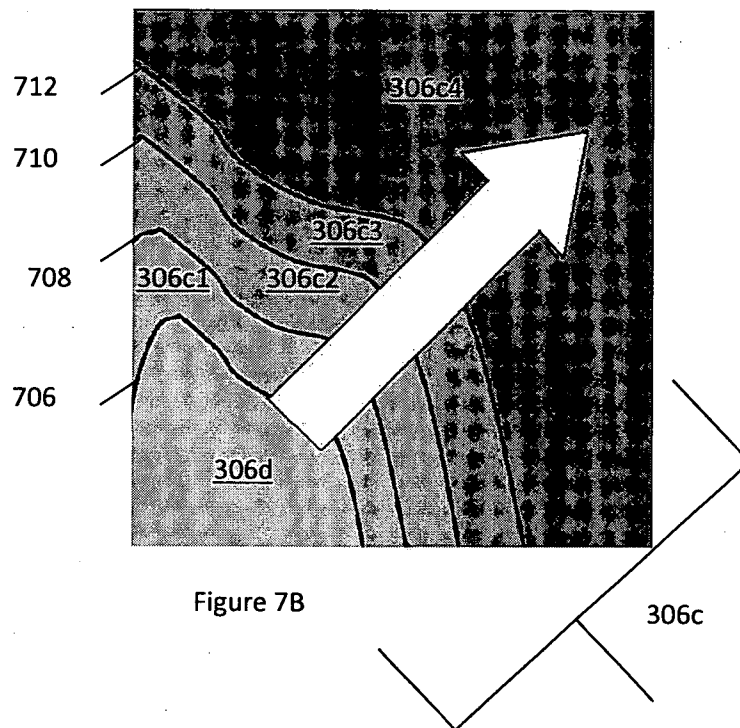


Figure 7B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/MY2010/000116

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

H04N 7/18 (2006.01) **G08B 21/22** (2006.01)

Action Date: 01 October 2010

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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)

WPI, EPODOC, INSPEC with keywords surveillance, video, camera, zone, boundary, security index, segment and similar terms.
Google Patents, Google Scholar, and Google searched with similar terms as above.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 7088846 B2 (HAN et al.) 08 August 2006 See the whole document in particular the abstract, figures 1B, 2A-2F, column 4 line 49 to column 5 line 13, and column 5 line 61 to column 6 line 24.	1-8
A	US 7023469 B1 (OLSON) 04 April 2006 See the whole document.	
A	US 2007/0257986 A1 (IVANOV et al.) 08 November 2007 See the whole document.	



Further documents are listed in the continuation of Box C



See patent family annex

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
01 October 2010

Date of mailing of the international search report
13 OCT 2010

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/MY2010/000116

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

[See Supplemental Box 1]

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/MY2010/000116

Supplemental Box 1

(To be used when the space in any of Boxes I to IV is not sufficient)

Continuation of Box No: III

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

In assessing whether there is more than one invention claimed, I have given consideration to those features which can be considered to potentially distinguish the claimed combination of features from the prior art. Where different claims have different distinguishing features they define different inventions.

This International Searching Authority has found that there are different inventions as follows:

- **Claims 1-5** are directed to a system for surveillance having a control module with a display which receives images of the surveillance area captured by a video camera, and programmed instructions to define one or more secured zones within the area; allocating a security index to the secured zones, and computing a response based on the security index when a non permitted object is within said secured zone. It is considered that *"allocating a security index to the secured zones, and computing a response based on the security index when a non permitted object is within said secured zone"* comprises a first distinguishing feature.
- **Claims 6-8** are directed to a method for surveillance by acquiring video images; defining one or more secured zones within the surveillance area; segmenting the secured zone into plurality of secured zone segments and assigning a security index to each of the secured zone segment. It is considered that *"segmenting the secured zone into plurality of secured zone segments and assigning a security index to each of the secured zone segment"* comprises a second distinguishing feature.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

Each of the abovementioned groups of claims has a different distinguishing feature and they do not share any feature which could satisfy the requirement for being a special technical feature. Because there is no common special technical feature it follows that there is no technical relationship between the identified inventions. Therefore the claims do not satisfy the requirement of unity of invention *a priori*.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/MY2010/000116

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member	
US 7088846	US 2005104727	US 2005105765	US 7127083
	US 2005104962	US 7136507	US 2005104961
	US 7148912	US 7499571	US 2005104959
	US 2005104960	US 2005105764	WO 2005050581
US 7023469	EP 0967584	JP 11355762	US 6385772
	US 6816184	US 6937651	
US 2007257986	JP 2007299381		
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.			
END OF ANNEX			