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(54) Title: A TRACKING AND MOVEMENT MONITORING SYSTEM AND A METHOD THEREOF

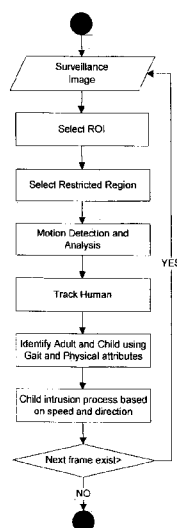


Figure 1

(57) Abstract: A tracking and analyzing system of at least one subject in an environment is provided, the system includes an image sensor, an image viewing means, wherein a plurality of live images captured by the image sensor is viewable successively on the image viewing means, a motion detection module which receives the plurality of live images captured by the image sensor and an alarm which his triggerable by the motion detection module, wherein a restricted region of the environment is definable by a user.



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A TRACKING AND MOVEMENT MONITORING SYSTEM AND A METHOD THEREOF

FIELD OF INVENTION

The present invention relates to a tracking and analyzing system of at least one subject in an environment and a method thereof.

BACKGROUND OF INVENTION

Children are constantly exposed to danger in everywhere. Every year, thousands of toddlers lose their lives or are injured in various household accidents. Potential hazards such as swimming pools, staircases and balconies pose a greater threat to a child's safety when the child is present in its vicinity without the supervision of an adult. Child accidents, for example, falling and drowning, can be avoided by restricting children from accessing high risk area even without the supervision of an adult.

US 6720880 describes a method and apparatus for monitoring locations using vision based technologies for automatically triggering safety measures when a child is detected under field of view. However, criteria used to determine whether a child is in danger is not sufficient as field of view is not a reliable measure for triggering safety measures.

Therefore, there is a need for reliable solution to monitor and track children to ensure their safety is not compromised in environments that may not necessarily include adults.

SUMMARY OF INVENTION

Accordingly there is provided a tracking and analyzing system of at least one subject in an environment, the system includes an image sensor, an image viewing means, wherein a plurality of live images captured by the image sensor is viewable successively on the image viewing means, a motion detection module which receives the plurality of live images captured by the image sensor and an alarm which is triggerable by the motion detection module, wherein a restricted region of the environment is definable by a user.

There is also provided a method of tracking and analyzing movement of at least one subject in an environment, the method includes the steps of obtaining at least one image, determining a restricted region in the environment, classifying motion detection of at least one subject in the at least one image into motion of at least one adult or at least one child, determining location of the at least one child, analyzing speed and direction of movement of the at least one child and triggering an alarm.

The present invention consists of several novel features and a combination of parts hereinafter fully described and illustrated in the accompanying description and drawings, it being understood that various changes in the details may be made without departing from the scope of the invention or sacrificing any of the advantages of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be fully understood from the detailed description given herein below and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention, wherein:

Figure 1 illustrates a flowchart of a method in a preferred embodiment of the invention;

Figure 2 illustrates flowchart of a method of determining triggering level of alarms when a child is in close proximity to the restricted region in a preferred embodiment of the invention;

Figure 3 illustrates flowchart of a method of determining triggering level of alarms when a child is in further proximity to the restricted region in a preferred embodiment of the invention;

Figure 4 illustrates factors that affect gait analysis in a method of the preferred embodiment of the invention; and

Figure 5 illustrates an example of a restricted region defined in the preferred embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention relates to a tracking and analyzing system of at least one subject in an environment and a method thereof. Hereinafter, this specification will describe the present invention according to the preferred embodiment of the present invention. However, it is to be understood that limiting the description to the preferred embodiment of the invention is merely to facilitate discussion of the present invention and it is envisioned that those skilled in the art may devise various modifications and equivalents without departing from the scope of the appended claims.

The following detailed description of the preferred embodiment will now be described in accordance with the attached drawings, either individually or in combination.

A preferred embodiment of the present invention provides for a tracking and analyzing system of at least one subject in an environment. The system includes an image sensor, an image viewing means, wherein a plurality of live images captured by the image sensor is viewable successively on the image viewing means, a motion detection module which receives the plurality of live images captured by the image sensor, and an alarm which is triggerable by the motion detection module, wherein a restricted region of the environment is definable by a user. The image sensor includes a camera means for capturing a sequence of images which may be selected from but not restricted to, a video camera, an Internet Protocol (IP) video camera and a still camera. The image viewing means used in this embodiment of the invention is a monitor. The at least one subject in this example is at least one adult or at least one child to be monitored in a restricted region.

The restricted region is shown as seen in Figure 5 to be a user selected region. In this embodiment, the restricted region is considered to be a high risk area that is dangerous to children.

Analysis is conducted based on a combination of human detection and tracking as well as classification based on gait analysis and physical attributes. Analysis of different conditions is based on speed and direction to provide varying levels of alarm triggers.

A method of tracking and analyzing movement of at least one subject in an environment is described as seen in Figure 1. The method includes the steps of obtaining at least one image, determining a restricted region in the environment, classifying motion detection of at least one subject in the at least one image into motion of at least one adult or at least one child, determining location of the at least one child, analyzing speed and direction of movement of the at least one child and triggering an alarm. An image of at least one adult is determined whether present within a high risk area simultaneously with an image of at least one child and a predetermined alarm level is triggered wherein the image of the at least one child is not accompanied by an image of at least one adult.

At least one surveillance image is obtained from an image sensor such as a camera, at a surveillance scene. A surveillance scene can be any areas potentially dangerous to children such as swimming pools or staircases. A restricted region is selected by a user that is defined as a dangerous area to children, wherein children are not allowed to access without presence of an adult within a predetermined distance as seen in Figure 5. The restricted region may then be framed using a plurality of shape selection tools to enclose the restricted region, regardless of geometrical shape of the restricted region.

Motion of subjects within the restricted region is then detected in the surveillance scene. Subsequently, cause of the motion will be analyzed to be either adult or children. Gait analysis is employed at this point to classify the subject as adult or a child. Various factors are taken into consideration for the gait analysis such as stride length of a child being shorter than that of an adult as well as head to body ratio as seen in Figure 4.

A corresponding level of alarm is triggered based on speed, location and direction of the child to alert any personnel or authorized party to attend to impending danger to the child.

A series of XY-coordinates corresponding to movement of subjects within the surveillance scene is then provided. Figures 2 and 3 illustrate the method based on speed, location and direction of the child. Figure 2 shows an embodiment of the method wherein the child is at a close proximity to the restricted region. Figure 3 shows an embodiment of the method wherein the child is at a further proximity to the restricted region. Close proximity of the child is defined as to how close the child is to the restricted region based on speed and direction of the child's movement as well the child's location.

As seen in Figure 2, presence of at least one adult next to the child is verified as being close to or in the restricted region. If at least one adult is confirmed to be present, speed of movement of the child is measured, as this indicates whether the child is running away from the at least one adult. A level 2 Alarm is triggered if the child is indeed found to be running away from the at least one adult. If the speed of movement is lower than a threshold value, the alarm is deactivated as it is to be understood that the child is safe under adult supervision even if the child is in the restricted region.

A maximum level of alarm, such as level 1, is triggered if children are found alone in close proximity to the restricted region or in the restricted region without an adult within the restricted region. If no response is detected after a predetermined period of time to attend to the child, a third part is summoned to the restricted region.

Figure 3 shows the steps of the method when the child is at a further proximity from an adult to determine a level of alarm to be triggered. An alarm level 3 is triggered when the child is found to be moving towards the restricted region at a fast pace. If the child is found to be moving towards the restricted region but at a slower pace, alarm level 4 is triggered. Further, the alarm will not be triggered or be deactivated if the child is found to not be moving towards the restricted region. It is to be understood that varying levels of alarms may be triggered indicating severity of danger in any situation based on surveillance images. The severity of danger and corresponding alarm levels may be determined by users of the system in advance.

In this example, there are at least seven different scenarios as a result of different speed and direction to determine various levels of alarms to be triggered as seen below:

1. A child is in or in close proximity to the restricted region and no adults are within a predetermined distance with the child.
2. A child is in or in close proximity to the restricted region and at least one adult is present within a predetermined distance with the child. The child is found to be moving away from the at least one adult.
3. A child is at a further proximity to the restricted region and moving at a fast pace towards the restricted region.
4. A child is at a further proximity to the restricted region and moving slowly to the restricted region.

5. A child is at a further proximity to the restricted region and moving slowly away from the restricted region.
6. A child is at a further proximity to the restricted region and moving at a fast pace from the restricted region.
7. A child is in the restricted region with an adult and is not moving.

Scenarios 1, 2 and 3 will trigger Alarm Level 1, Level 2, Level 3 and Level 4 respectively. The alarm may be deactivated when the scenarios 4, 5, 6 or 7 happen.

Alarm Level 1 indicates that a situation is very dangerous and critically needs immediate action from an adult. A third party is part of the method to ensure that the incident does not go unattended to.

Alarm Level 2 indicates that a situation is relatively dangerous and the alarm level 2 alerts an adult who is present within the predetermined distance of the child.

Alarm Level 3 and 4 caution an adult that the child is running or walking respectively toward restricted region. The alarm may be deactivated when no possible danger is imminent and the child is safe.

It is to be appreciated that various combinations of the above mentioned scenarios may be matched to corresponding alarm levels based on application and requirement of a user in the system. The invention is significantly more efficient than prior art as child safety features take more factors into consideration such as location of the child, speed of movement of said child and direction of movement of said child. Varying levels of alarms are also a dependable indicator to danger levels of children in supervised or unsupervised environments.

It is to be understood that the embodiments of the invention described are exchangeable for other variations of the same in order to be used in various

applications. The present embodiment of the invention is intended for, but not safety monitoring of children in locations that may be hazardous.

CLAIMS

1. A tracking and analyzing system of at least one subject in an environment, the system includes:
 - i. an image sensor;
 - ii. an image viewing means, wherein a plurality of live images captured by the image sensor is viewable successively on the image viewing means;
 - iii. a motion detection module which receives the plurality of live images captured by the image sensor; and
 - iv. an alarm which is triggerable by the motion detection module, wherein a restricted region of the environment is definable by a user.
2. The system as claimed in claim 1, wherein the image sensor includes a camera means for capturing a sequence of images.
3. The system as claimed in claim 1, wherein the camera means includes a video camera, an Internet Protocol (IP) video camera and a still camera.
4. The system as claimed in claim 1, wherein image viewing means includes a monitor.
5. The system as claimed in claim 1, wherein the subject is at least one adult.
6. The system as claimed in claim 1, wherein the subject is at least one child.

7. A method of tracking and analyzing movement of at least one subject in an environment, the method includes the steps of:
- i. obtaining at least one image;
 - ii. determining a restricted region in the environment;
 - iii. classifying motion detection of at least one subject in the at least one image into motion of at least one adult or at least one child;
 - iv. determining location of the at least one child;
 - v. analyzing speed and direction of movement of the at least one child; and
 - vi. triggering an alarm.
8. The method as claimed in claim 7, wherein determining location of the at least one child further includes the steps of:
- i. determining whether an image of at least one adult is present within a high risk area simultaneously with an image of at least one child;
 - ii. triggering a predetermined alarm level,
- wherein the image of the at least one child is not accompanied by an image of at least one adult.

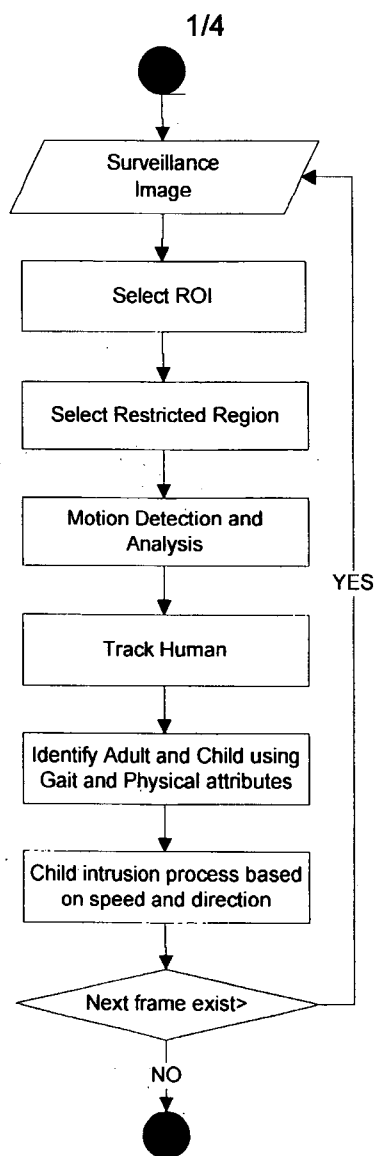


Figure 1

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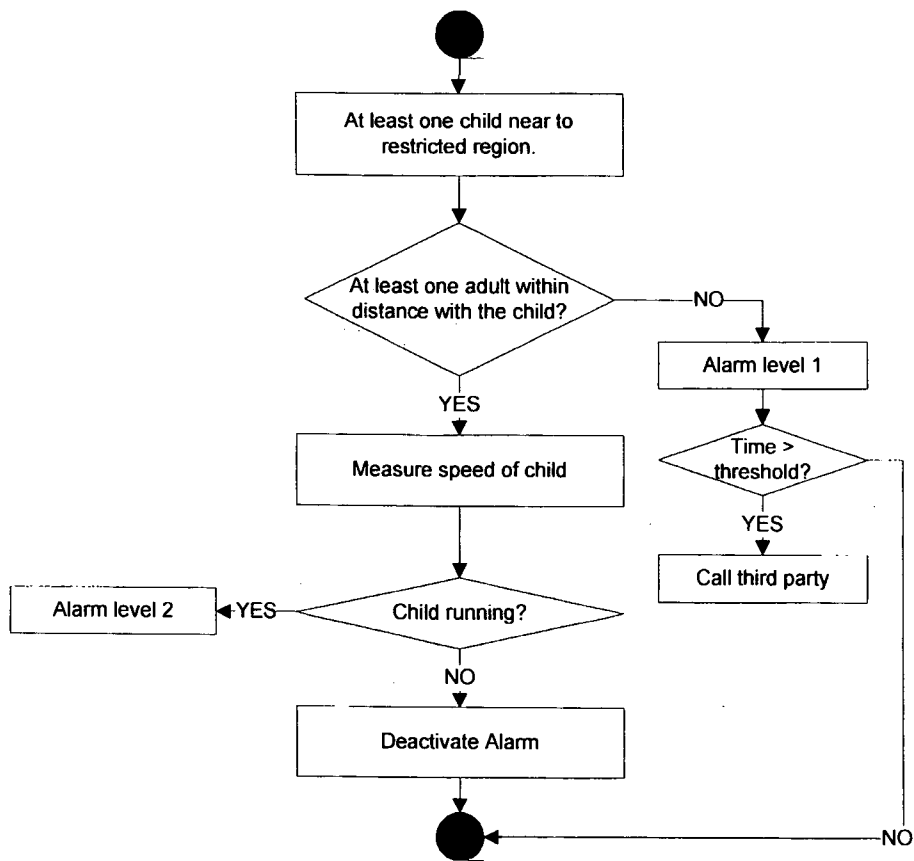


Figure 2

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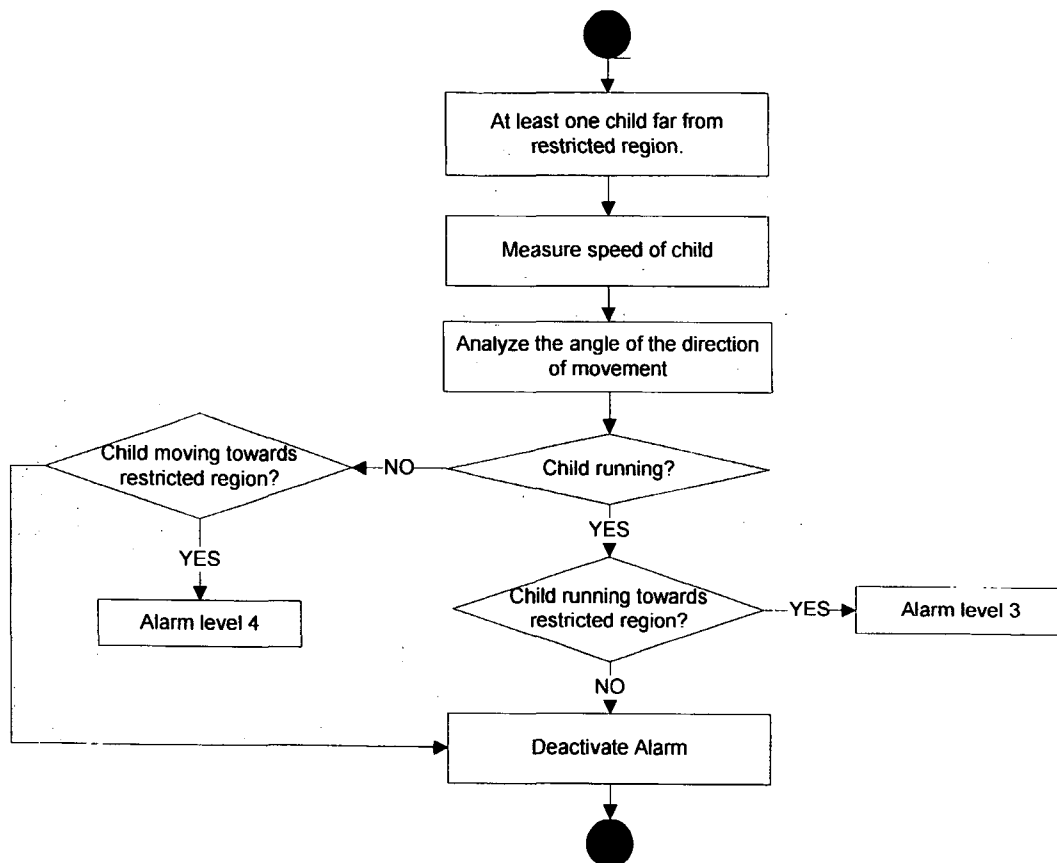


Figure 3

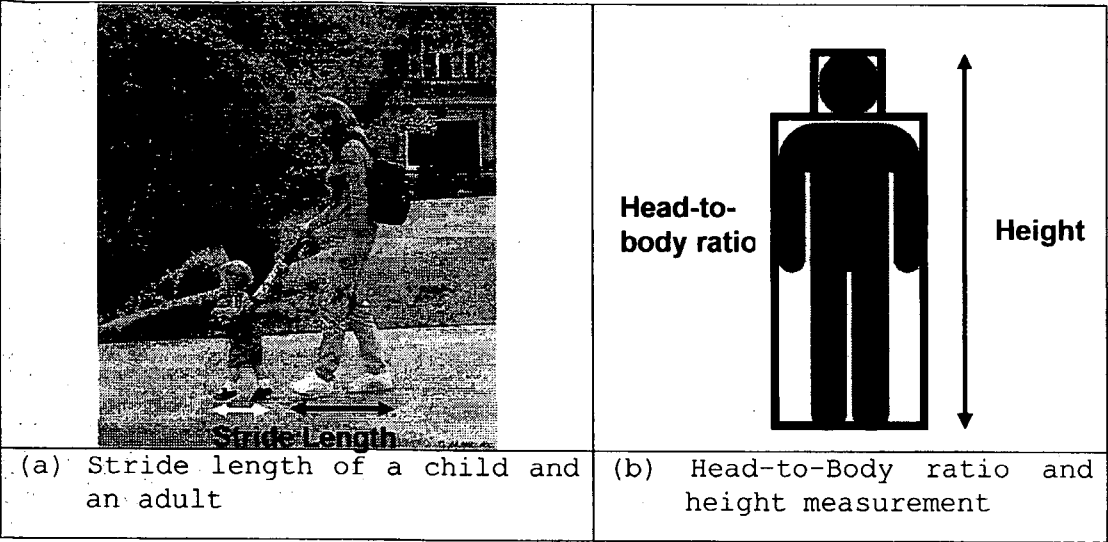


Figure 4

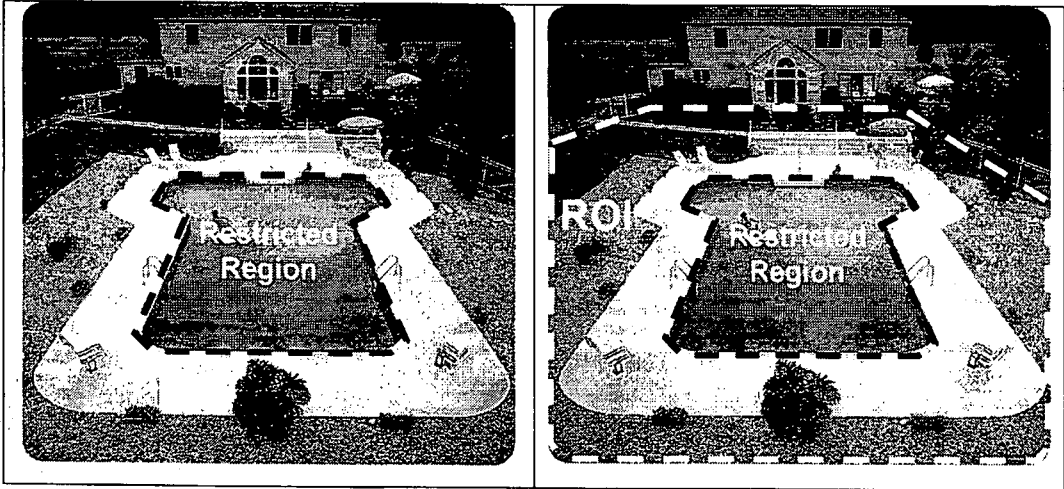


Figure 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/MY2010/000184**A. CLASSIFICATION OF SUBJECT MATTER****G08B 21/02(2006.01)i, G08B 23/00(2006.01)i, H04N 7/18(2006.01)i**

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)

G08B 21/02; G08B 27/00; H04N 7/18; G01B 11/24; G08B 21/00; G08B 13/196; G08C 17/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: image, camera, sensor, monitor, motion, alarm, child

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2009-0091539 A (DONGSEO TECHNOLOGY HEADQUARTERS) 28 August 2009 See abstract, claims 1-11 and figures 1-6	1-8
X	KR 20-0430806 Y1 (SENPLUS CO., LTD. et al.) 13 November 2006 See abstract, claims 1-8 and figures 1-4	1-8
A	JP 2004-096457 A (SUMITOMO OSAKA CEMENT CO LTD) 25 March 2004 See abstract, claims 1-5 and figures 1-3	1-8
A	KR 10-2001-0038264 A (SAMSUNG ELECTRONICS CO., LTD.) 15 May 2001 See abstract, claims 1-4 and figures 1-6	1-8
A	KR 10-0376417 B1 (MIYAMOTO TAMOTSU) 17 March 2003 See abstract, claims 1-3 and figures 1-2	1-8

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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