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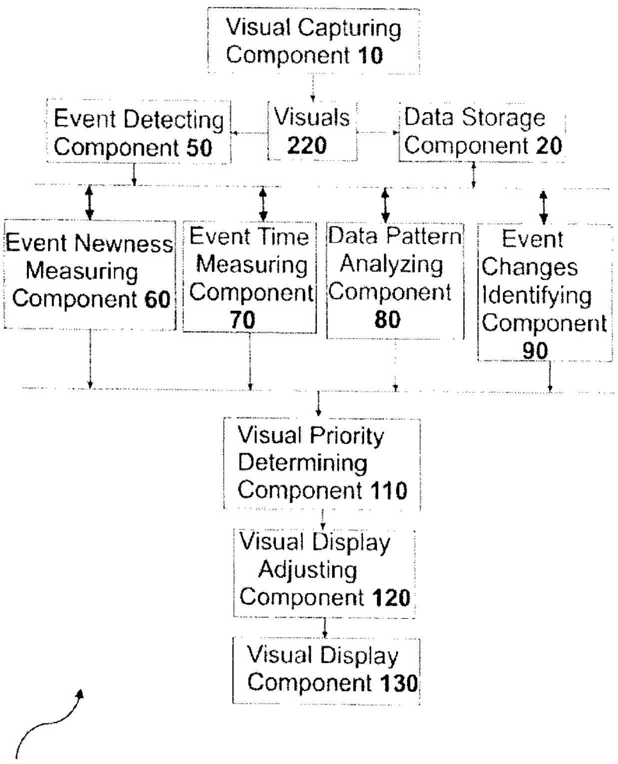

100

FIG. 2

(57) Abstract: The present invention relates to a system (100) for determining priority of visuals (220) and a method thereof. The system (100) comprises a plurality of visual capturing components (10) for capturing visuals (220); an event detecting component (50) for detecting events in the visuals (220) associated with each of the visual capturing component (10) and a visual priority determining component (110) for determining the priority of the visuals (220) of the visual capturing component (10) based on a set of parameters.

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A SYSTEM AND A METHOD FOR DETERMINING PRIORITY OF VISUALS

FIELD OF THE INVENTION

The present invention relates to a system and a method for determining priority of visuals.

BACKGROUND ART

In olden days too theft and burglary were common and premises were guarded manually or by relying on human labor. The advances in technology led to the advent of cameras and cameras slowly replaced the traditional ways to monitor a premise.

Nevertheless, a small number of cameras were never adequate to monitor a large premise. A large number of cameras were usually required instead. Thereby, it became difficult for users to monitor a large number of cameras simultaneously via a display screen for guarding a premise. Due to the difficulty in monitoring large number of cameras there were many instances in which users missed important events in the visuals recorded by cameras which were displayed on the display screen. As such, there arose a need for an automated mechanism that detects events to assist users with their security needs.

To overcome the above drawback video analytics was introduced. Video analytics was conceived to assist these users to detect events captured by video cameras, which assisted users to observe a display showing multiple video feeds from a large number of cameras at the same time to detect an important event. Usually in such video analytics or conventional camera-monitoring systems, all the video footages or visuals were shown with equal window frame size as shown in FIG. 1. These video analytics were usually accompanied with visual or auditory alerting systems that alert users when an event occurs.

Further, in scenarios where a premise gets very busy that is, crowded with people, many events take place at once. The conventional video analytics detect such events and report them to be important but in fact they might not be that important. The important events being the events that require the users' attention, these events are associated with threats to the security in a premise. For example, special occasions like a function or the like might be happening in the premise but the video analytics still identifies these events regardless of their importance. Apart from that, sometimes, renovation or temporary works like maintenance might also be occurring in the premise but the video analytics do not detect these events without having regard to their importance or relevancy. Still further, these video analytics might also detect events that were recurring events. Usually, the security personnel may just disregard such events by temporarily or permanently removing such detected events.

Thus, conventional video analytics detect events regardless of the importance of the events; the less important detected events are bound to "drown out" the more important ones. In this connection, users might be distracted from the more important detected events by the less important events. As a consequence, users may not know whether a detected event requires their attention or not, if the importance of the events is not indicated. Although there are visual or auditory alerts being provided, no state of urgency or priority is being indicated in these alert messages or being depicted in the final footage of these visuals from all the cameras.

If the importance, relevance, the priority or the like of these visuals is not indicated, irrespective of the number of events being detected by the video analytics, users will not be able to spot the important events. This would lead to consuming a lot of users' time and effort in manually reviewing footages being displayed on the screen. The situation may be worse if there is an increase in the number of cameras i.e. more visuals from the cameras to monitor. Ultimately, this would lead to undesirable misdetections on user's or security personnel's end. This further implies that these conventional video analytics are only limited to detecting events and do not have the capability to detect important and relevant events that require the users' immediate attention.

Due to the dearth of efficient video analytics in such areas, there appears a need for a system and a method that is able to determine the priority of visuals from cameras and facilitate users to focus their attention on important events.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a system and a method for determining priority of visuals.

According to one aspect of the present invention, the system comprises a plurality of visual capturing components; a data storage component for obtaining and storing data in relation to the visuals of each of the visual capturing components; an event detecting component for detecting events in the visuals associated with each of the visual capturing component; an event newness measuring component for identifying the type of the detected event based on a newness degree of how new the event is, and assigning an event value in relation to the event based on the type to the visuals of the visual capturing component; an event time measuring component for measuring the event time when the detected event occurs, and the event time duration passed between a past event and a detected event both with similar event values; a data pattern analyzing component for analyzing the data pattern in relation to the detected event; an event changes identifying component for determining whether there are changes to the detected event; and a visual priority determining component for determining the priority of the visuals of the visual capturing component based on the event value, the time value, the pattern value, and the event changes value.

Regarding the event detecting component, the event is detected when there is a presence in relation to objects appearing in the visuals.

In the event newness measuring component, the newness degree is related to how unique the detected event is in comparison to the past data in relation to the events of the same event value.

Apart from what that is mentioned above, the event time measuring component is further adapted to assign a time value based on the event time and the event time duration to the visuals of the visual capturing component.

On a further note, the data pattern analyzing component is further adapted to compare the past data and the recent data in relation to the events of the same event value, determine a degree of similarity between the past data and the recent data of the events of the same event value, and assign a pattern value based on the degree of similarity to the visuals of the visual capturing component.

The event identifying component is further adapted to determine a degree of changes with respect to the detected event based on the objects appearing on the detected event through identifying whether there are changes in the past and recent data in relation to the detected event; and assigning an event changes value based on the degree of changes to the visuals of the visual capturing component.

On the other hand, the visual priority determining component is further adapted for adjusting a display of the visuals of the visual capturing components based on the determined priority.

It is also an object of the present invention to provide a system and a method for determining priority of visuals that prevent users from cases of misdetection regarding the detected events in the visuals. As such, the users are prevented from being distracted by less important detected events in the visuals, as well as to prevent the more important events from being "drown-out" by the less important events. In this connection, the users are able to make better judgment with regard to detecting the important events in the visuals in order to achieve better results of accuracy in terms of more relevant event detections.

It is a final object of the present invention to provide a system and a method for determining priority of visuals that determine the priority of the visuals coming out from the visual capturing units in accordance to a user's adjustable weight. In other words, the user can adjust the weights in terms of determining the priority of the visuals from the visual capturing components, for example in the system itself, such that the visuals from the visual capturing components depicting an event with more priority can be detected and alerted to the user according to the user's need.

According to another aspect of the present invention, the method for determining priority of visuals comprising the steps of acquiring the visuals using a plurality of visual capturing components, obtaining and storing data in relation to the visuals of each of the visual capturing components using a data storage component; detecting events in the visuals associated with each of the visual capturing component using an event detecting component; identifying the type of the detected event based on a newness degree of how new the event is, and assigning an event value in relation to the event based on the type to the visuals of the visual capturing component using an event newness measuring component; measuring the event time when the detected event occurs, and the event time duration passed between a past event and a detected event both with similar event values, and assigning a time value based on the event time and the event time duration to the visuals of the visual capturing component using an event time measuring component; analyzing the data pattern in relation to the detected event using a data pattern analyzing component; determining a degree of changes with respect to the detected event based on the objects appearing on the detected event using an event changes identifying component; and determining the priority of the visuals of the visual capturing component based on the event value, the time value, the pattern value, and the event changes value; and adjusting a display of the visuals of the visual capturing components based on the determined priority using a visual priority determining component.

It is an object of the present invention to provide a system and a method that determine priority of visuals from visual capturing components using metadata analytics. Essential data are obtained from the visual of each visual capturing component and then those data are analyzed using metadata analytics method to determine the priority of the visuals of the visual capturing components. In other words, the visual capturing components are ranked according to their determined priority such that the more attention-worthy visuals can be facilitated to be brought to a user's attention.

Further than that, it is also an object of the present invention to provide a system and a method for determining priority of visuals from visual capturing components that rank the visuals from the visual capturing components according to their determined priority and adjust the display of the visuals of each visual capturing component according to their determined priority. For example, in order to show the visuals according to the priority of the visual capturing components, the positioning and the display size of the visuals are adjusted according to the priority of the visual capturing components. For instance, the visuals from the visual capturing component with more priority are shown at higher position or with larger display screen.

The present invention consists of certain novel features and a combination of parts hereinafter fully described and illustrated in the accompanying drawings and particularly pointed out in the appended claims; it being understood that various changes in the details may be without departing from the scope of the invention or sacrificing any of the advantages of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

For the purpose of facilitating an understanding of the invention, there is illustrated in the accompanying drawings the preferred embodiments from an inspection of which when considered in connection with the following description, the invention, its construction and operation and many of its advantages would be readily understood and appreciated.

FIG. 1 shows an exemplary layout and display of a conventional camera-monitoring system;

FIG. 2 shows a schematic of the system for determining priority of visuals in accordance with the present invention;

FIG. 3 is a flowchart showing the steps involved in detecting incoming events by the event detecting component in accordance with this invention;

FIG. 4 is a flowchart showing the steps involved in loading a historic profile or generating a new data section by a data storage component in accordance with this invention;

FIG. 5 is a flowchart showing the steps carried out for displaying visuals based on the determined priority or terminating the display in accordance with this invention;

FIG. 6 is a flowchart showing the steps involved in determining priority of visuals in accordance with this invention;

FIG. 7 is a flowchart showing the steps carried out by the system in order to display visuals on the visual displaying component in accordance with this invention;

FIG. 8 is an exemplary diagram showing the measurement and significance of time decay in accordance with this invention;

FIG. 9 is an exemplary diagram showing the measurement and significance of event changes determined by the 'event changes identifying component' in accordance with this invention;

FIG. 10 is an exemplary diagram showing the steps involved in obtaining the profile of a number of detections for each visual capturing component (10) across time in accordance with this invention;

FIG. 11 is an exemplary diagram showing the object(s) captured in a detected event in the visuals (220) of one of the visual capturing component (10) in accordance with this invention; and

FIGS. 12 & 13 are exemplary diagrams showing the ranking as well as positioning of the visuals on the visual displaying component (130) in terms of the determined priority of the visuals (220) in accordance with this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A detailed description of the preferred embodiments of the invention is disclosed herein. It should be understood, however that the preferred embodiments are merely exemplary of the invention, which may be embodied in various forms or configurations. Therefore the details disclosed herein are not to be interpreted as limiting but merely as the basis for the claims and for teaching one skilled in the art of the invention.

The present invention relates to a system (100) and a method for determining priority of visuals (220). Hereinafter, the system (100) and the method shall be described according to the preferred embodiments of the present invention and by referring to the accompanying description and drawings. However, it is to be understood that limiting the description to the preferred embodiments of the invention and to the drawings is merely to facilitate discussion of the present invention and it is envisioned that those skilled in the art may devise various modifications without departing from the scope of the appended claim.

Referring to FIG. 2-13, there is shown the system (100) and the method of the present invention.

With reference to FIG. 2 now, according to one aspect of the present invention, the system (100) comprises a plurality of visual capturing components (10), a data storage component (20), an event detecting component (50), an event newness measuring component (60), an event time measuring component (70), a data pattern analyzing component (80), an event changes identifying component (90), and a visual priority determining component (110).

The visual capturing components, collectively represented by reference numeral (10) are adapted for capturing visuals (220); the visual capturing components (10) are shown in FIG. 1 & 2. In the system (100), generally, a large number of such visual capturing components (10) are required for monitoring for instance, large buildings, a car park or the like premises. Usually, these visual capturing components (10) are installed at different locations to cover a wide area under surveillance or a wide angle of view.

Referring now to FIG. 2, the data storage component (20) is adapted for storing data in relation to the visuals (220) for each of the visual capturing components (10). Next, the event detecting component (50) is adapted to detect events in the visuals (220) captured by each of the visual capturing components (10). Whenever an object (210) makes a presence within the line of sight of the visual capturing component (10) as illustrated in FIG. 11, the event detecting component (50) detects the event.

On the other hand, still referring to FIG. 2, the event newness measuring component (60) is adapted for identifying the type of the detected event based on a newness degree of how new the event is, and assigning an event value in relation to the event based on the type assigned to the visuals (220) of the visual capturing component (10). The newness degree relates to how unique the detected event is in comparison to the past data in relation to the events of the same event value.

The event time measuring component (70) is adapted to measure the event time when the detected event occurs, and the event time duration passed between a past event and a detected event both with similar event values. The event time measuring component (70) is further adapted to assign a time value based on the event time and the event time duration to the visuals (220) of the visual capturing component (10).

The data pattern analyzing component (80) is adapted to analyze the data pattern in relation to the detected event. The data pattern analyzing component (80) is further adapted to compare the past data and the recent data in relation to the events of the same event value, determine a degree of similarity between the past data and the recent data of the events of the same event value, and assign a pattern value based on the degree of similarity to the visuals (220) of the visual capturing component (10).

The event changes identifying component (90) is adapted to determine whether there are changes to the detected event. The event changes identifying component (90) is further adapted to determine a degree of changes with respect to the detected event based on the objects appearing on the detected event through identifying whether there are changes in the past and recent data in relation to the detected event, and assign an event changes value based on the degree of changes to the visuals (220) of the visual capturing component (10).

The visual priority determining component (110) is adapted to determine the priority of the visuals (220) of the visual capturing component (10) based on the event value, the time value, the pattern value, and the event changes value. The visual priority determining component (110) is further adapted for adjusting a display of the visuals (220) of the visual capturing components (10) based on the determined priority.

Referring to FIG. 3 & 4, the data storage component (20) stores the data in data sections according to the visual capturing components (10). As shown in FIG. 4, the data storage component (20) generates a new data section when there is no data section dedicated to the visual capturing component (10) stored in the data storage component (20).

With reference to FIG. 3 now, the data storage component (20) is further adapted for starting up the data section before storing the data in relation to the visuals (220) of the visual capturing component (10) in the data storage component (20). Before that, the data storage component (20) checks whether such data section for such an event with the same event value for that particular visual capturing component (10) exists.

The system (100) is firstly connected to the data storage component (20), for example a database (DB). Then, the data storage component (20) checks whether such data section for the event with the same event value exists with respect to that particular visual capturing component (10) that records the same event. Otherwise, the data storage component (20) loads up the existing data sections corresponding to the event with the same event value for the visual capturing component (10) as stored in the data storage component (20) before.

Returning back to FIG. 3, upon checking at this stage the event detecting component (50) starts listening for or detecting incoming events. If there is an incoming event detected, the identification number of the visual capturing component (10) that records the event is obtained. Next, as mentioned above, the type of the detected event is identified based on the newness of how new the event is. Then, the metadata regarding the incoming event is obtained. In this connection, the event time measuring component (70), the data pattern analyzing component (80), and the event changes identifying component (90) perform their respective analysis.

As shown in FIG. 3, upon detecting the event, the storage component (20) detects events in the visuals (220) and the data storage component (20) updates the data section in relation to the visual capturing component (10).

Further to this stage i.e. listening to the incoming events, with reference to FIG. 5, the next step is for calculating and determining the priority of the visual capturing components (10). Next, the visual priority determining component (110) is further adapted for updating the display of the visuals (220) of the visual capturing components (10) based on the determined priority, as will be described hereinafter.

Referring still to FIG. 5, subsequently after the display is updated, the user may request for termination. In this case, the process of determining priority of visuals (220) of the visual priority determining component (110) ends.

Referring now to FIG. 6, which is the process conducted by the system (100), the system (100) initially assign weights W_1, W_2, and W_3 based on a user's configuration (after the visual capturing components (10) have recorded the visuals (220)). Then, the event detecting component (50) detects or listens for the events in the visuals (220) recorded by the visual capturing components (10). As mentioned before, the event newness measuring component (60) identifies the type of the detected event based on the newness degree of the event itself. Basically, the event newness measuring component (60) increments an event value of N for that particular visual capturing component (10).

Referring to FIG. 7, which is the process conducted by the system (100), the system (100) gets the visuals acquired by the visual capturing components (10) and based on the priority determined by visual priority determining component (110) calculates the size for all future visuals according to the display or canvas size. The acquired visuals are then accordingly scaled to fill or to cover the complete visual displaying component (130).

Referring to FIG. 6 & 8, the event time measuring component (70) is tasked to measure the time of the visuals (220) acquired by the visual capturing component (10) based on the event time, and the event time duration mentioned above. As an instance, the event time measuring component (70) calculates the time elapsed between the preceding event and the succeeding event detected by the event detecting component (50) and recorded by the visual capturing components (10). Later, the event time measuring component (70) implements the time decay as the time value. The time decay is normalized between 1 and 0 for the time value. For example, the time decay T is set as the inverse of the time elapsed between the preceding and succeeding events and normalized between 0 and 1.

Referring still to FIG. 8, in light of the above, with reference to the graph Time Decay (T) versus time, events are considered fresher if the time elapsed between the preceding event and the succeeding event are longer. As such, the time decay is inversely proportional to the time elapsed between the preceding and succeeding events. With reference to the graph N (event value) versus Time, the new events (the peaks) are considered fresh events that increasingly become stale due to the increasing time decay.

Next, with reference to FIG. 6 & 10, the data pattern analyzing component (80) obtains all the past data and the recent data of the visuals (220) associated with one of the visual capturing components (10) in the data section in relation to the visual capturing component (10) and converts the past and recent data as past and recent vectors. For example, all the past values leading up to the current time of the event detected by the visual capturing component (10) in the historical and current profile (data sections) are obtained as vectors. As shown in FIG. 10, the profile of a number of detections for each visual capturing component (10) across time is obtained. It is preferred that the visual capturing component (10) is a camera, most particularly a video camera. Referring to the graph N, in which a number of events versus time, the current data and the historical data are compared. Events are considered fresh if they do not normally happen or do not repeat regularly.

The data pattern analyzing component (80) is further for conducting a data vector similarity measure on the past and recent vectors to determine the degree of similarity between the past data and the recent data. For example, a similarity measure between the two vectors (from the historical and the current profile) is conducted using a Cosine Similarity Measure. The Cosine Similarity Measure is used to compare the historical and the current data to get the pattern value of how similar the historical and current data are.

Later, the data pattern analyzing component (80) implements the result of the data vector similarity measure as the pattern value. The result of the data vector similarity measure ranges from value 1 to +1 to signify from being 'not similar' to 'being similar' for the implementation of the pattern value. For example, the results of the Cosine Similarity Measure are set as H (the pattern value variable) which ranges from 1 to +1 i.e. being 'not similar' to 'being similar'. The similarity measure informs that the current detected events are abnormal if it is not similar.

Next, referring to FIG. 6 & 9, the event changes identifying component (90) obtains the past data and the recent data with regard to the detected event. The event changes identifying component (90) determines the degree of changes to the detected event via the past and recent data, and implements the changes as the event changes its value. If there are no changes with regard to the detected event between the past data and the recent data, the event changes identifying component (90) implements the event changes value as 0. If there are changes in the detected event, the event changes identifying component (90) normalizes the event changes value to be between 0 and 1 based on the changes in the detected event.

The changes with regard to the detected event comprises the number of objects, the color of the objects, the size of the objects, and a combination of more than one of these changes. For example, with further reference to FIG. 11, the number of objects (210) in relation to a detected event appearing in the visuals (220) of one of the visual capturing component (10) is determined. If no object (210) appears in the visuals (220), the event changes value (M) is set as "0". Otherwise, if there is at least one object in relation to the detected event in the visuals (220) of one the visual capturing components (10), the number of the appearing objects (210) is set as the event changes value (M) and normalized between 0 and 1.

As shown in FIG. 9, referring to the graph of the event changes value (M) versus time, events are considered fresh if there is a change of metadata (the peak) between the current event and the previous event ($E_n - E_{n-1}$).

Next, the visual priority determining component (110) calculates the priority value P_{cam} of each of the visual capturing component (10) or camera as follows:

$$P_{cam} = (W_1 * N * T) + (W_2 * H) - (W_3 * M)$$

In accordance with this invention, priority of the visuals for each of the visual capturing component (10) or camera can also be determined using a subset of the aforementioned parameters, which are event value, time value, pattern value and event changes value. Thus, certain parameters may not be used for detecting the priority, and those parameters will be assigned value zero in the equation above for calculating priority value P_{cam}.

Referring to FIG. 12-13, the visual displaying component (130) further implements and displays the visuals (220) in terms of the positioning of the visuals (220) according to the determined priority in order to show the ranking of the visuals (220) from the visual capturing components (10) on the visual displaying component (130) in terms of the determined priority of the visuals (220) from the visual capturing component (10).

For example, the display is updated based on the determined priority order or rank by initially obtaining a plurality of images or visuals (220) from a plurality of cameras. The dimension of those obtained visuals (220) (particularly from a camera) is determined based on whether their dimension is the same as the dimension of that on the display screen. If they are the same, no action is taken. However, if their dimension of the obtained visuals (220) is found to be different from the dimension of that on the display screen, the dimension of all the future visuals (220) obtained from the same camera is to be set the same.

The dimension of the visuals (220) is calculated based on the display canvas or screen. Those visuals (220) are scaled and filled into overlays and then those scaled visuals are drawn from the overlays to the display screen.

Ultimately, the dimension of those visuals (220) is calculated based on the values in the priority order by scaling and normalizing the dimension of those visuals (220) to follow the ratio of the said priority order in order for the visuals (220) to be fitted into the display canvas or screen dimension.

Referring to FIG. 12 & 13, for example again, the visuals (220) obtained by a visual capturing component (10) that manage to depict an important event that requires the user's attention and that the visual capturing component (10) is determined to have a relatively higher priority (the range being from fresh to stale), the display size of the visuals (220) relatively has the largest display size and the highest position amongst other visuals (220) from other visual capturing components (10).

According to another aspect of the present invention, with reference to FIG. 1-13, the present invention is related to a method for determining priority of visuals (220).

The method comprises the steps of acquiring the visuals (220) using a plurality of visual capturing components (10); obtaining and storing data in relation to the visuals (220) of each of the visual capturing components (10) using a data storage component (20); detecting events in the visuals (220) associated with each of the visual capturing component (10) using an event detecting component (50); identifying the type of the detected event based on a newness degree of how new the event is, and assigning an event value in relation to the event based on the type to the visuals (220) of the visual capturing component (10) using an event newness measuring component (60); measuring the event time when the detected event occurs, and the event time duration passed between a past event and a detected event both with similar event values, and assigning a time value based on the event time and the event time duration to the visuals (220) of the visual capturing component (10) using an event time measuring component (70); analyzing the data pattern in relation to the detected event using a data pattern analyzing component (80); determining a degree of changes with respect to the detected event based on the objects appearing on the detected event using an event changes identifying component (90); identifying whether there are changes in the past and recent data in relation to the detected event, and assigning an event changes value based on the degree of changes to the visuals (220) of the visual capturing component (10); and determining the priority of the visuals (220) of the visual capturing component (10) based on the event value, the time value, the pattern value, and the event changes value; and adjusting a display of the visuals (220) of the visual capturing components (10) based on the determined priority using a visual priority determining component (110).

The event is detected when there is a presence in relation to objects (210) appearing in the visuals (220). On the other hand, the newness degree is related to how unique the detected event is in comparison to the past data in relation to the events of the same event value.

Regarding the step of analyzing the data pattern in relation to the detected event, the step comprises the steps of comparing the past data and the recent data in relation to the events of the same event value, determining a degree of similarity between the past data and the recent data of the events of the same event value, and assigning a pattern value based on the degree of similarity to the visuals (220) of the visual capturing component (10).

Regarding the step of determining a degree of changes with respect to the detected event, the step comprises identifying whether there are changes in the past and recent data in relation to the detected event, and assigning an event changes value based on the degree of changes to the visuals (220) of the visual capturing component (10).

Referring now to FIG. 3 & 4, the data are stored in data sections according to the visual capturing components (10) in the data storage component (20). Referring specifically to FIG. 4 now, the system (100) is connected to the data storage component (20), for example a database (DB). The data storage component (20) is checked whether such a data section is available for such an event with the same event value for that particular visual capturing component (10). If such a data section dedicated to the visual capturing component (10) is absent or has not been created in the data storage component (20), a new data section is generated. Next, when such a data section is created or has been available, the data section proceeds to initialization.

As shown in FIG. 3, after the checking stage, any incoming events are detected. If there is an incoming event detected, the identification number of the visual capturing component (10) recording the event is obtained. This also includes the type of the detected event identified based on the newness of how new the event is. This is further extended to obtaining the metadata regarding the incoming event. After this, analysis is performed on these extracted data.

Subsequently, the priority of the visual capturing components (10) is calculated and determined. Once the priority of the visual capturing components (10) is determined, the display of the visuals of the visual capturing components (10) is updated based on the determined priority. At this stage, the user is allowed to terminate the process. If this is the case, the process of determining priority of visuals (220) of the visual priority determining component (110) ends once it is terminated.

In FIG. 6, weights W_1, W_2, and W_3 are assigned based on a user's configuration when the visual capturing components (10) start recording visuals (220). Then, events are being detected in the visuals (220) recorded by the visual capturing components (10). Once the events are detected, the type of the detected event is identified based on the newness degree of the event itself. Based on the identified type, an event value of N is incremented for that particular visual capturing component (10).

Referring now to FIG. 6 & 8, the time decay of the visuals (220) acquired by the visual capturing component (70) is measured based on the event time, and the event time duration. The time elapsed between the preceding event and the succeeding event detected by the event detecting component (50) is calculated. The time decay is implemented as the time value. The time decay is normalized between 1 and 0 for the time value. As an example, the time decay T is set as the inverse of the time elapsed between the preceding and succeeding events and normalized between 0 and 1.

In light of the above, in FIG. 8, according to the graph Time Decay (T) versus time, the longer the time elapsed between the preceding event and the succeeding event, the fresher the event is considered. This shows that the time decay is inversely proportional to the time elapsed between the preceding and succeeding events. As shown in the graph N (the event value) versus Time in FIG. 8, the new events (the peaks) i.e. the fresh events become increasingly stale as the time decay increases.

According to FIG. 6 & 10 now, all the past data and the recent data of the visuals (220) in relation to the visual capturing components (10) in the data section in relation to a specific visual capturing component (10) are obtained. These past and recent data are converted as past and recent vectors. In FIG. 10, with reference to the table, the profile of a number of detections for each visual capturing component (10) across the time is obtained. The visual capturing component (10) is preferred to be a camera, or more precisely, a video camera. Based on the graph number of events versus time, the current data and the historical data are compared and if the events do not normally happen (based on the graph), the events are considered fresh.

Consequently, a data vector similarity measure is conducted on the past and recent vectors in order to determine the degree of similarity between the past data and the recent data. As an example, a Cosine Similarity Measure is used to conduct a similarity measure between the two vectors (from the historical and the current profile). Next, the historical data and the current data are compared in order to determine the pattern value of how similar the historical and current data are.

Later, the result of the data vector similarity measure is implemented to range from 1 to +1 (i.e. being not similar to being similar) as the pattern value. For instance, the results of the Cosine Similarity Measure are set such that they range from 1 to +1 i.e. being not similar to being similar as H (the pattern value variable).

As shown in FIG. 6 & 9, the past data and the recent data are obtained with regard to the detected event. The degree of changes to the detected event is determined based on the past and recent data. The changes are then implemented as the event changes value. If no changes are detected between the past data and the recent data, the event changes value is implemented as 0. If changes in the detected event are being detected, the event changes value is normalized between 0 and 1 based on the changes in the detected event.

The changes with regard to the detected event comprises the number of objects (210), the color of the objects, the size of the objects, and a combination of more than one of these changes. Apart from that, any other changes regarding the objects (210) or the background in the visuals (220) is allowed to be taken account as the changes. For example, as illustrated in FIG. 11, the number of objects (210) in relation to a detected event appearing in the visuals (220) of one of the visual capturing component (10) is obtained and determined. If no object (210) is detected in the visuals (220), the event changes value (M) is set as "0". Otherwise, if at least one object in relation to the detected event is detected in the visuals (220) of one the visual capturing components (10), the number of the appearing objects (210) is set as the event changes value (M) and normalized between 0 and 1.

Referring to the graph of the event changes value (M) versus time in FIG. 9, events are considered fresh if there is a change of metadata (the peak) between the current event and the previous event ($E_n - E_{n-1}$).

Then, the priority value P_{cam} of each of the visual capturing component (10) or camera is calculated as follows:

$$P_{cam} = (W_1 * N * T) + (W_2 * H) - (W_3 * M)$$

In accordance with this invention, priority of the visuals for each of the visual capturing component (10) or camera can also be determined using a subset of the aforementioned parameters, which are event value, time value, pattern value and event changes value. Thus, certain parameters may not be used for detecting the priority, and those parameters will be assigned value zero in the equation above for calculating priority value P_{cam}.

With reference to FIG. 12-13, the visuals (220) are implemented and displayed in terms of the positioning of the visuals (220) according to the determined priority in order to show the ranking of the visuals (220) from the visual capturing components (10) on the visual displaying component (130) in accordance to the determined priority of the visuals (220) from the visual capturing component (10).

For example, a plurality of images or visuals (220) is initially obtained from a plurality of cameras before the display is updated based on the determined priority order or rank. Next, the dimension of those obtained visuals (220) (particularly from a camera) is determined whether their dimension is similar to the dimension of the display screen. No action is taken if the dimension of the visuals (220) is found to be the same. However, if the dimension of the visuals (220) and the display screen is different, the dimension of the visuals (220) from the camera is set to be the same as the dimension of the display screen (not shown).

The dimension of the visuals (220) is calculated based on the display canvas or screen. These visuals (220) are scaled and filled into overlays and the overlays are scaled and drawn to the display screen.

As much as the dimension of those visuals (220) is calculated based on the values in the priority order, the dimension of the visuals (220) is also being scaled and normalized in accordance to the ratio of the said priority order in order to fit the visuals (220) to the dimension of the display canvas or screen.

As an example, as shown in FIG. 12 & 13, the visuals (220) from the respective cameras are shown in a cascading manner in terms of size and positioning according to the priority order of those cameras i.e. the visuals (220) from the camera that bear the more important event and that require more attention, and have a relatively higher priority, have relatively a larger display size and a higher position than other visuals (220) from other cameras.

While in the foregoing specification this invention has been described in relation to certain preferred embodiments thereof and many details have been set forth for purpose of illustration, it will be apparent to those skilled in the art that the invention is susceptible to additional embodiments and that certain of the details described herein can be varied considerably without departing from the basic principles of the invention.

CLAIMS

1. A system (100) for determining priority of visuals (220) comprising:
   i. a plurality of visual capturing components (10) for capturing visuals (220);
   ii. a data storage component (20) for receiving the captured visuals for each of said visual capturing components (10) and storing data in relation to the captured visuals (220);
   iii. an event detecting component (50) for detecting at least one event in the captured visuals (220) associated with each of said visual capturing component (10); and
   iv. a visual priority determining component (110) adapted for determining the priority of the visuals (220) of said visual capturing component (10) based on at least one parameter selected from the group consisting of a event value, a time value, a pattern value, and a event changes value or combinations thereof; said visual priority determining component (110) further adapted for adjusting a display of the visuals (220) of said visual capturing components (10) based on said determined priority.

2. The system (100) as claimed in Claim 1, wherein said system (100) further comprises at least one of the following components:
   i. an event newness measuring component (60) for identifying a type of said detected event based on a newness degree and assigning said event value based on said type assigned to the visuals (220);
   ii. an event time measuring component (70) for measuring an event time and an event time duration passed between a past event and a detected event both with similar event values; said event time measuring component (70) being further for assigning said time value based on said event time and said event time duration associated with the visuals (220), wherein said time value is implemented as a time decay and said time decay is normalized between 1 and 0 for said time value;
   iii. a data pattern analyzing component (80) for analyzing a data pattern in relation to said detected event; said data pattern analyzing component (80) being further for comparing and determine a degree of similarity between a past data and a recent data in relation to the events having the same event value and assigning said pattern value based on the degree of similarity associated with the visuals (220); and
   iv. an event changes identifying component (90) for determining whether

there are changes to said detected event; said event identifying component (90) being further for determining a degree of changes with respect to said detected event to assign said event changes value to the visuals (220),

wherein each of said aforementioned components receive said data in relation to the captured visuals (220) from said data storage component (20) and said detected event from said event detecting component (50) and provide a parameter value to said visual priority determining component (110) for further processing and said data storage component (20) for storage.

3. The system (100) as claimed in Claim 2, wherein said data pattern analyzing component (80) obtains all the past data and the recent data of the visuals (220) from said data storage component (20) and converts said past and said recent data as past and recent vectors; and further said data pattern analyzing component (80) implements said pattern value as the result of the data vector similarity measure ranging from value 1 to +1 to signify from being not similar to being similar; and

4. The system (100) as claimed in Claim 2, wherein said event changes identifying component (90) implements the event changes value as 0 if there are no changes with regard to said detected event; and if there are changes in said detected event, said event changes identifying component (90) normalizes the event changes value to be between 0 and 1 based on the changes in said detected event; wherein the changes with regards to said detected event comprise the number of objects, the color of the objects, the size of the objects, and a combination of more than one of these changes.

5. The system (100) as claimed in Claim 1, wherein said system (100) further comprises a visual displaying component (130) for displaying the visuals (220) based on their determined positioning and said determined priority; and the visual priority determining component (110) further comprises a visual display adjusting component (120); the visual display adjusting component (120) for determining a display size of the visuals (220), converting said display size of the visuals (220) using said determined priority, determining a converted display size of the visuals (220) based on the display size of the visual display component (130), implementing and displaying said display size of the visuals (220) in accordance to said determined priority to said display size of the visual display component (130).

6. A method for determining priority of visuals (220) comprises the following steps:
    i. acquiring visuals (220) using a plurality of visual capturing components (10);
    ii. obtaining and storing data in relation to the captured visuals (220) for each of the visual capturing components (10) in a data storage component (20);
    iii. detecting at least one event in the captured visuals (220) associated with each of said visual capturing component (10) using an event detecting component (50); the event being detected when there is a presence in relation to objects (210) appearing in the visuals (220);
    iv. determining the priority of the visuals (220) of the visual capturing component (10) based on at least one parameter selected from the group consisting of a event value, a time value, a pattern value, a event changes value and a combination thereof; and
    v. adjusting a display of the visuals (220) of the visual capturing components (10) based on the determined priority using a visual priority determining component (110).

7. The method as claimed in Claim 6, wherein the step determining the priority of the visuals (220) of the visual capturing component (10) based on at least one parameter includes the following steps:
    i. identifying the type of the detected event based on a newness degree and assigning said event value in relation to the event based on the type assigned to the visuals (220) of the visual capturing component (10) using an event newness measuring component (60); said newness degree being how unique the detected event is in comparison to the past data in relation to the events of the same event value;
    ii. measuring a event time when the detected event occurs, and a event time duration passed between a past event and a detected event both with similar event values, and assigning said time value based on the event time and the event time duration to the visuals (220) of said visual capturing component (10) using an event time measuring component (70), wherein said time value is implemented as a time decay and said time decay is normalized between 1 and 0 for said time value;
    iii. analyzing the data pattern in relation to the detected event using a data pattern analyzing component (80) through comparing the past data and the recent data in relation to the events of the same event value, determining a degree of similarity between the past data and the recent data of the events of the same event value, and assigning said pattern value based on the

degree of similarity to the visuals (220) of the visual capturing component (10); and

iv. determining a degree of changes with respect to the detected event based on the objects appearing on the detected event using an event changes identifying component (90) through identifying whether there are changes in the past and recent data in relation to said detected event, and assigning said event changes value based on the degree of changes to the visuals (220) of said visual capturing component (10).

8. The method as claimed in Claim 6, wherein the step of analyzing the data pattern in relation to the detected event using the data pattern analyzing component (80) comprises the steps of:

i. obtaining all the past data and the recent data of the visuals (220) associated with each one of said visual capturing components (10);

ii. converting the past and recent data as past and recent vectors;

iii. conducting a data vector similarity measure on the past and recent vectors to determine the degree of similarity between the past data and the recent data; and

iv. implementing the result of the data vector similarity measure as the pattern value; wherein the result of the data vector similarity measure ranges from value 1 to +1 to signify from being not similar to being similar for the implementation of the pattern value.

9. The method as claimed in Claim 6, wherein the step of determining whether there are changes to the detected event using an event changes identifying component (90) comprises the steps of:

i. obtaining the past data and the recent data with regard to said detected event;

ii. determining the degree of changes to said detected event via the past and recent data, and

iii. implementing the changes as the event changes value; wherein if there are no changes with regard to said detected event between the past data and the recent data, the event changes value is implemented as 0; and if there are changes in said detected event, the event changes value is to be normalized between 0 and 1 based on the changes in the detected event, wherein said changes with regard to said detected event comprises the number of objects, the colour of the objects, the size of the objects, and a combination of more than one of these changes.

10. The method as claimed in Claim 6, wherein the step of adjusting a display of the visuals (220) of the visual capturing components (10) based on the determined priority using a visual priority determining component (110) comprises the steps of:
    i. determining the display size of the visuals (220) acquired by said visual capturing components (10);
    ii. converting a display size of the visuals (220) using said determined priority;
    iii. determining the converted display size of the visuals (220) based on the display size of a visual display component (130); and
    iv. implementing the display size of the visuals (220) and displaying the visuals (220) in accordance to said determined priority to said display size of the visual display component (130); and
    v. implementing and displaying the visuals (220) in terms of the positioning of the visuals (220) according to the determined priority in order to show the ranking of the visuals (220) from said visual capturing components (10) on said visual displaying component (130) in terms of said determined priority of the visuals (220) from the visual capturing component (10) using a visual display adjusting component (120).

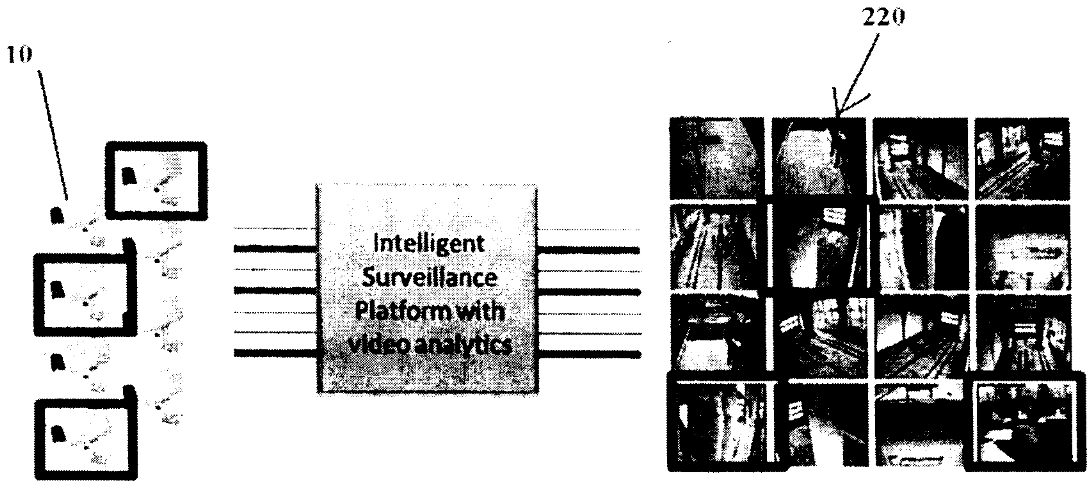

10
220
Intelligent
Surveillance
Platform with
video analytics

FIG. 1

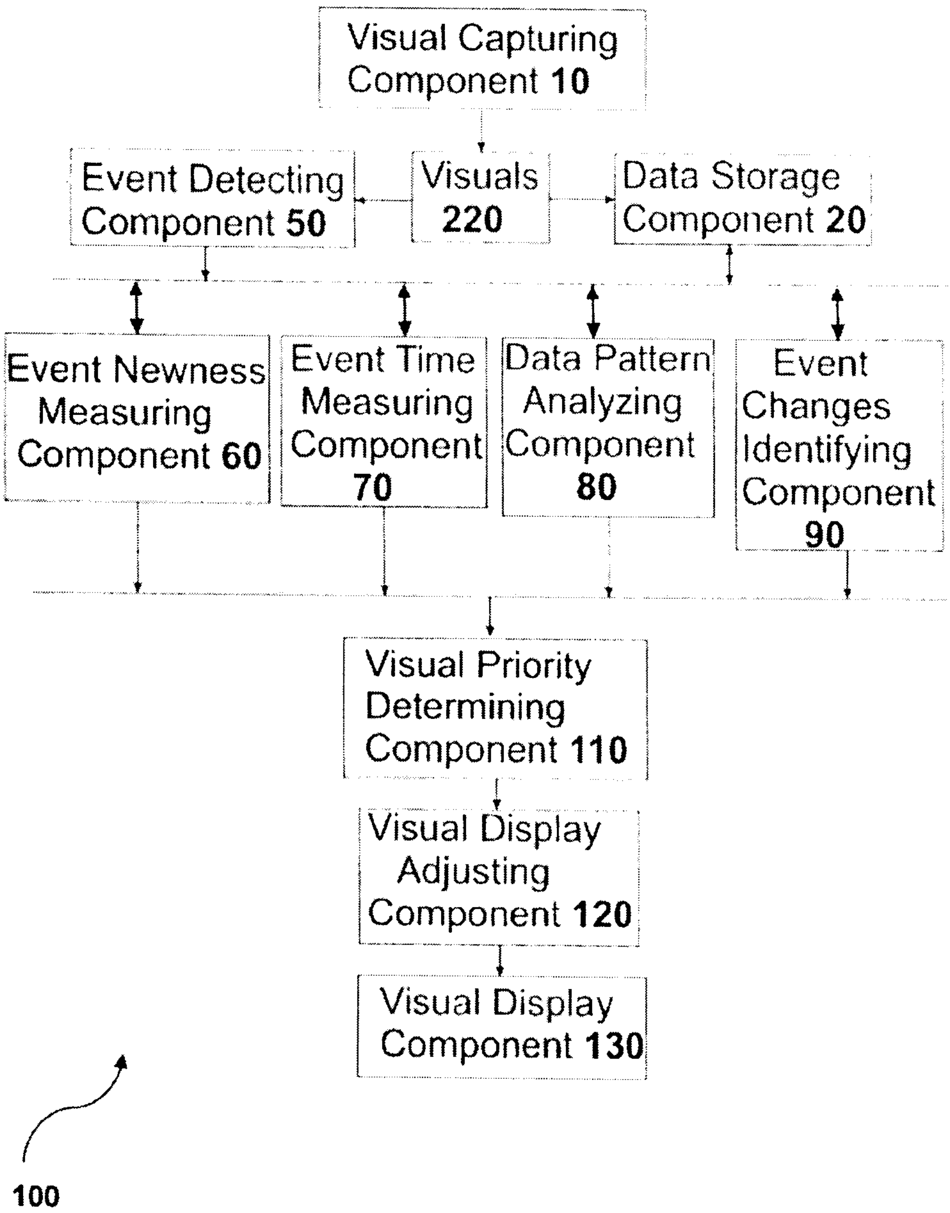

Visual Capturing Component 10
Event Detecting Component 50
Visuals 220
Data Storage Component 20
Event Newness Measuring Component 60
Event Time Measuring Component 70
Data Pattern Analyzing Component 80
Event Changes Identifying Component 90
Visual Priority Determining Component 110
Visual Display Adjusting Component 120
Visual Display Component 130
100

FIG. 2

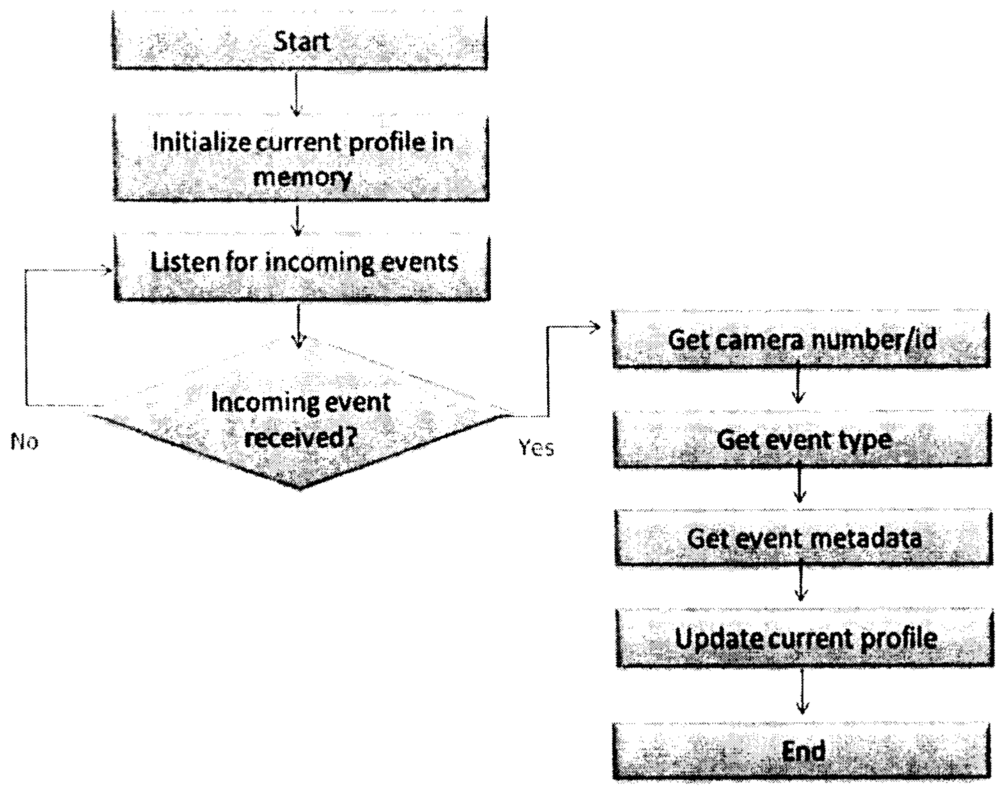
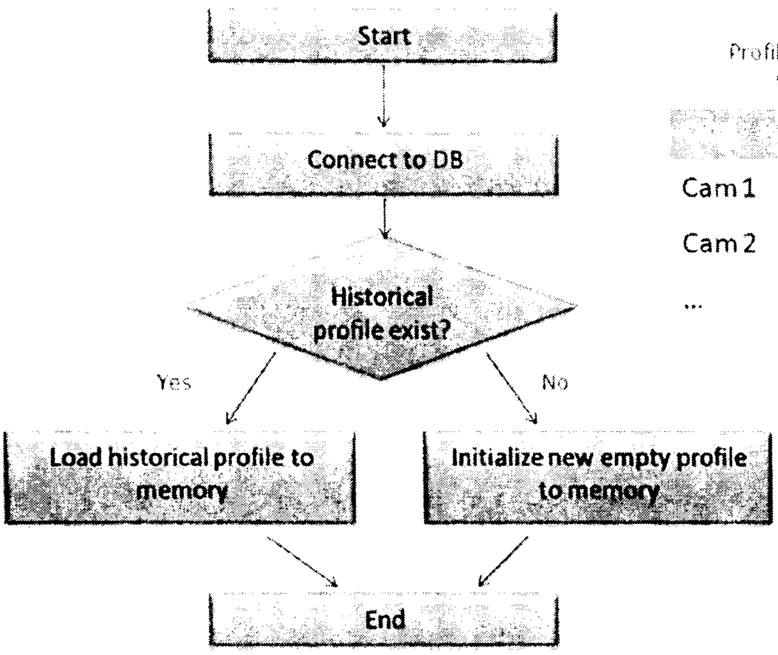

Start
Initialize current profile in memory
Listen for incoming events
Incoming event received?
No
Yes
Get camera number/id
Get event type
Get event metadata
Update current profile
End

FIG. 3



Profile of number of detections for each camera across time

[illegible]	[illegible]	[illegible]	[illegible]
Cam 1	5	0	
Cam 2	8	1	
...			

FIG. 4

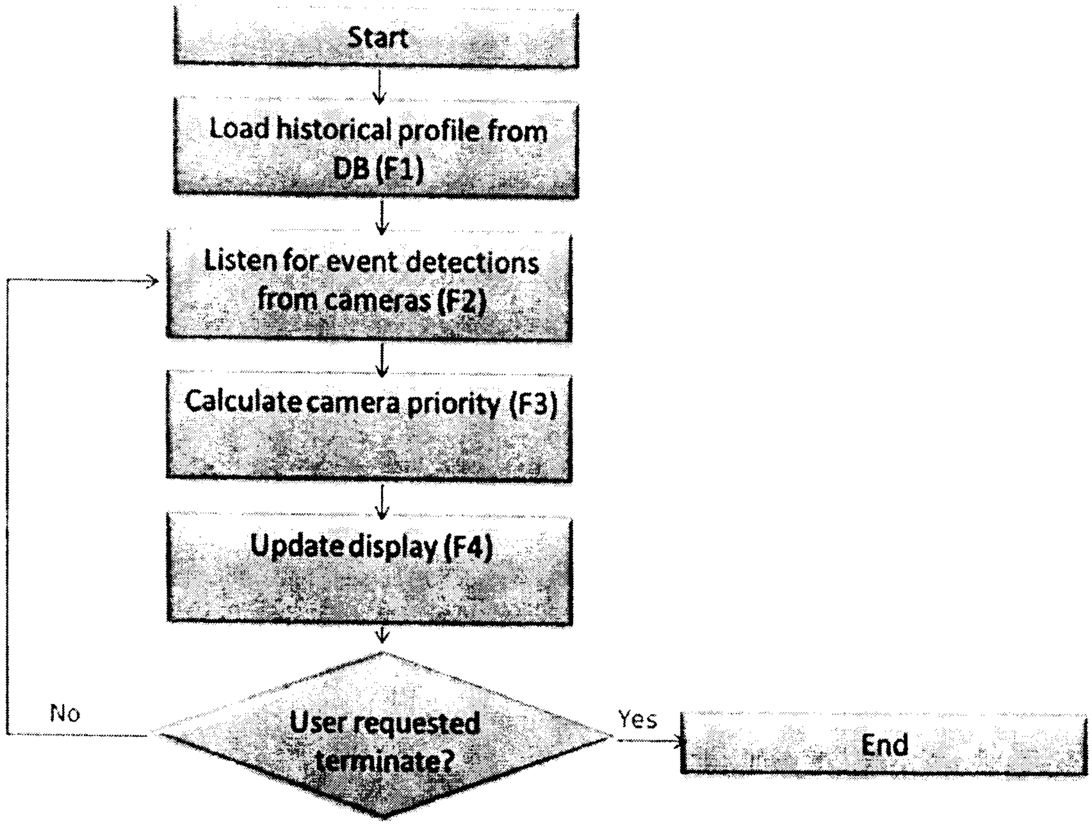

Start
Load historical profile from DB (F1)
Listen for event detections from cameras (F2)
Calculate camera priority (F3)
Update display (F4)
User requested terminate?
No
Yes
End

FIG. 5

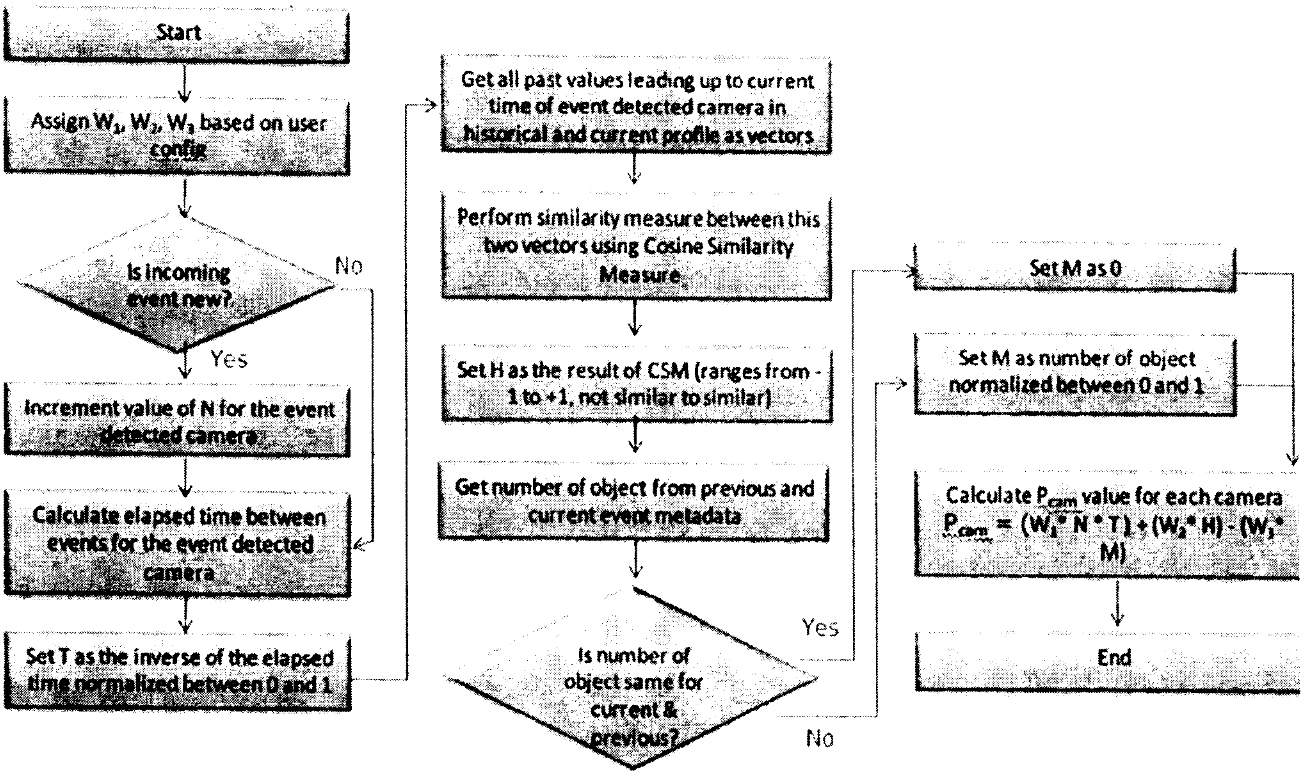

Start
Assign W_1, W_2, W_3 based on user config
Is incoming event new?
No
Yes
Increment value of N for the event detected camera
Calculate elapsed time between events for the event detected camera
Set T as the inverse of the elapsed time normalized between 0 and 1
Get all past values leading up to current time of event detected camera in historical and current profile as vectors
Perform similarity measure between this two vectors using Cosine Similarity Measure
Set H as the result of CSM (ranges from -1 to +1, not similar to similar)
Get number of object from previous and current event metadata
Is number of object same for current & previous?
Yes
No
Set M as 0
Set M as number of object normalized between 0 and 1
Calculate P_{cam} value for each camera $P_{cam} = (W_1 * N * T) + (W_2 * H) - (W_3 * M)$
End

FIG. 6

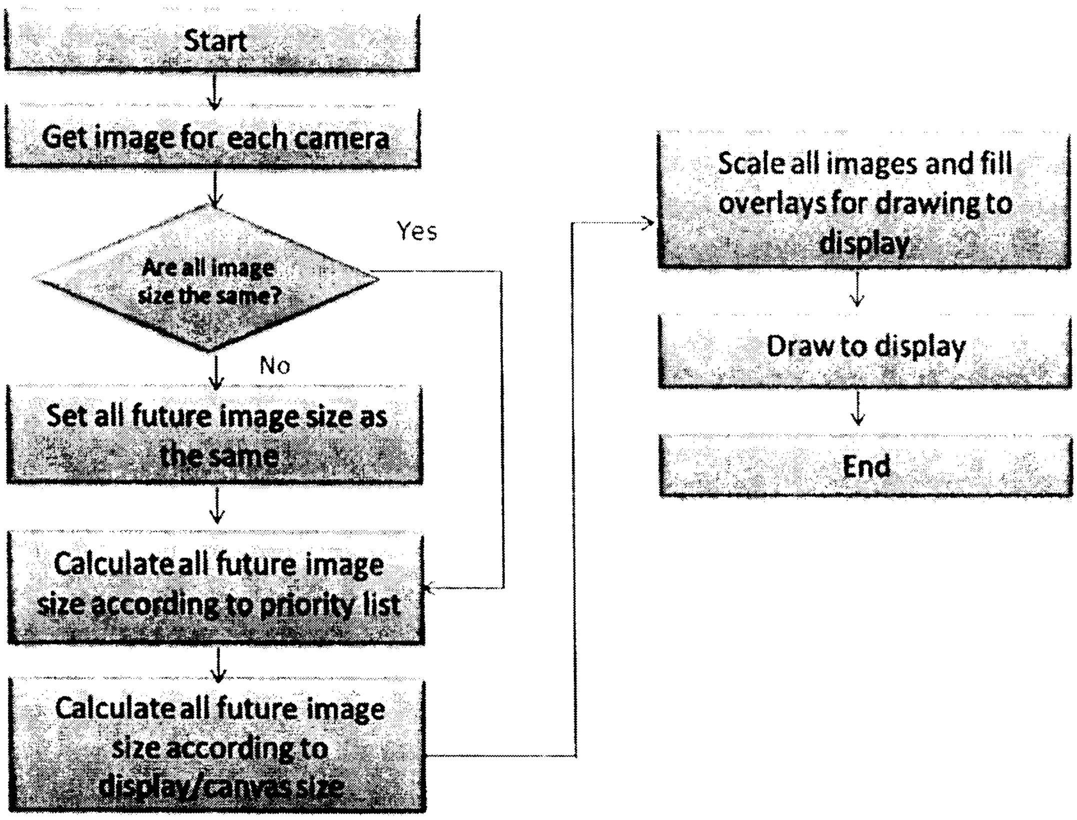
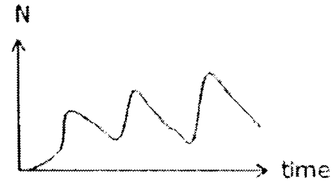

Start
Get image for each camera
Are all image size the same?
Yes
No
Set all future image size as the same
Calculate all future image size according to priority list
Calculate all future image size according to display/canvas size
Scale all images and fill overlays for drawing to display
Draw to display
End

FIG. 7

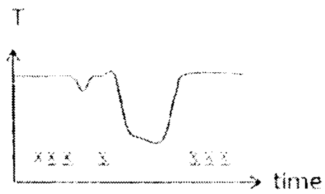
For each camera, their priority number is calculated as:

$$P_{cam} = \underbrace{\boxed{(W_1 * N * T)}}_{\text{Time decay factor}} - (W_2 * H) - (W_3 * M)$$

$$\textbf{Time Decay} \propto \frac{\textbf{1}}{\textbf{Time elapsed between events}}$$



New events are fresh events that increasingly become stale due to T



Events are fresher if time between events are bigger (time decay inversely related to time elapsed between events)

FIG. 8

For each camera, their priority number is calculated as:

$$P_{cam} = (W_1 * N * T) - (W_2 * H) + \boxed{(W_3 * M)}$$

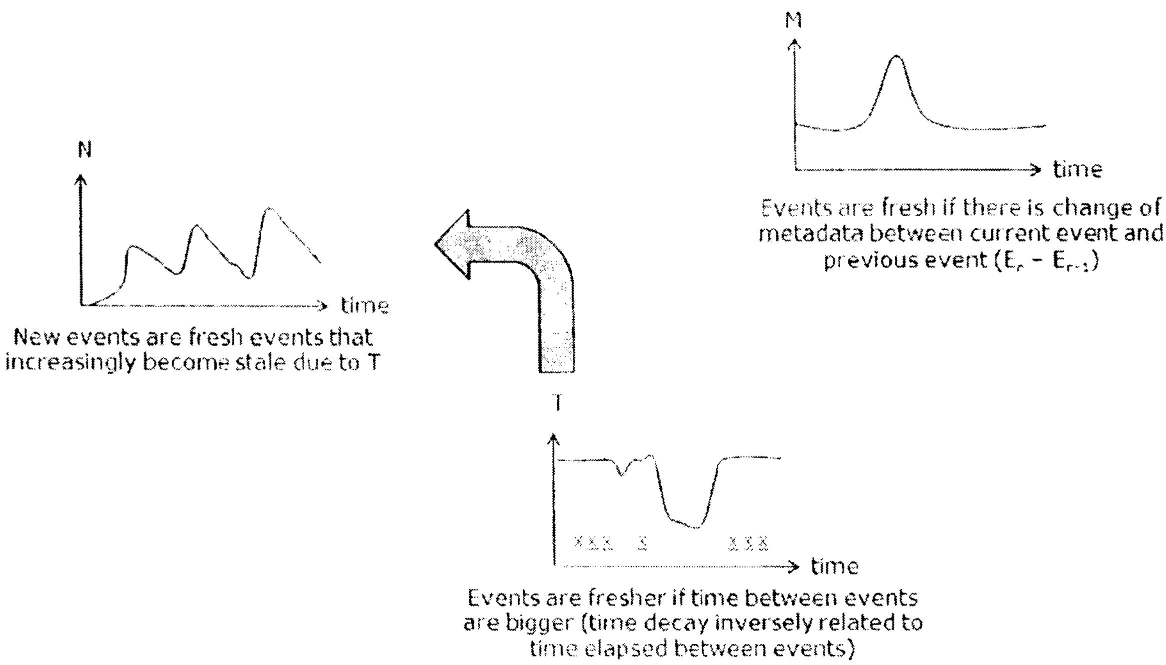


FIG. 9

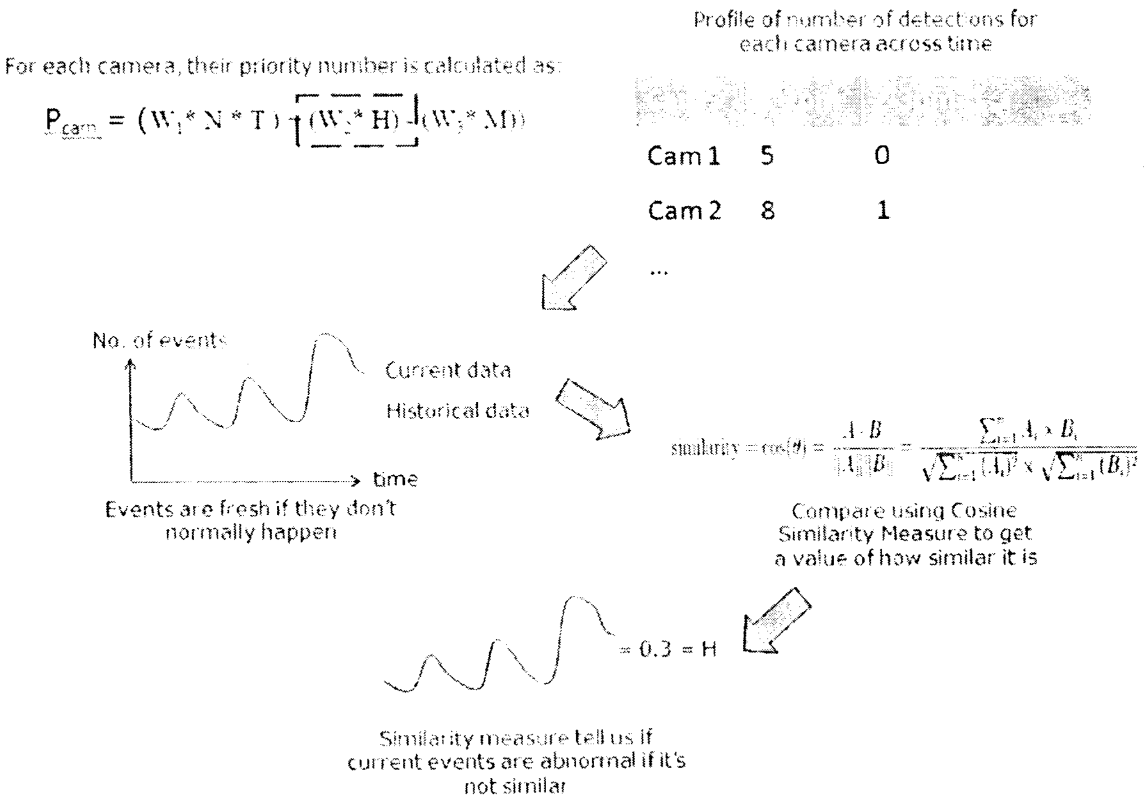

Profile of number of detections for each camera across time
For each camera, their priority number is calculated as:
$P_{cam} = (W_1 * N * T) + (W_2 * H) + (W_3 * M)$
Cam 1 5 0
Cam 2 8 1
...
No. of events
Current data
Historical data
time
Events are fresh if they don't normally happen
$similarity = \cos(\theta) = \frac{A \cdot B}{\|A\| \|B\|} = \frac{\sum_{i=1}^{n} A_i \times B_i}{\sqrt{\sum_{i=1}^{n} (A_i)^2} \times \sqrt{\sum_{i=1}^{n} (B_i)^2}}$
Compare using Cosine Similarity Measure to get a value of how similar it is
= 0.3 = H
Similarity measure tell us if current events are abnormal if it's not similar

FIG. 10

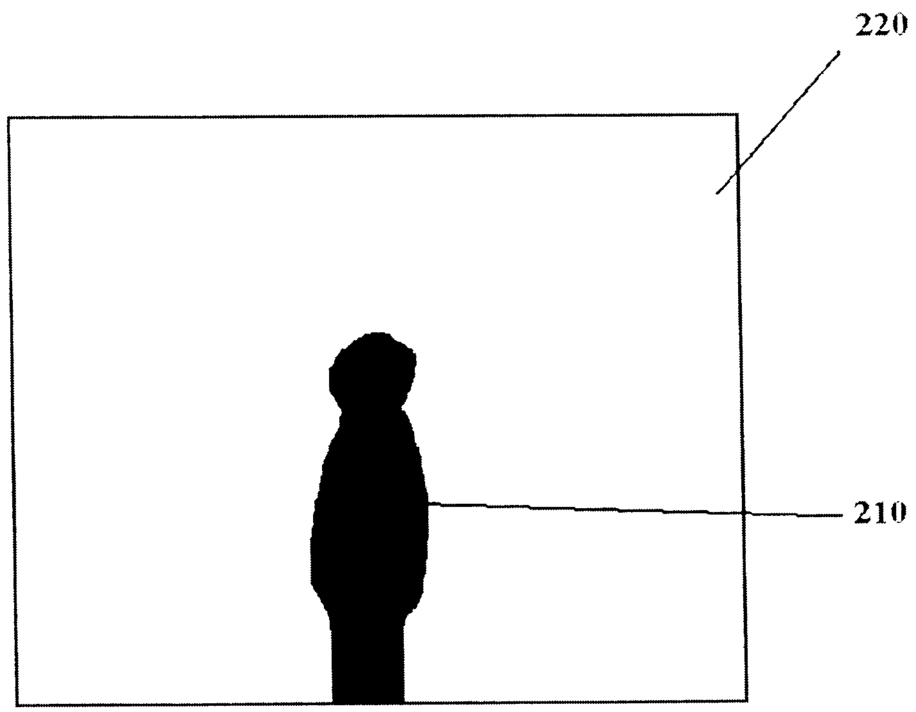


FIG. 11

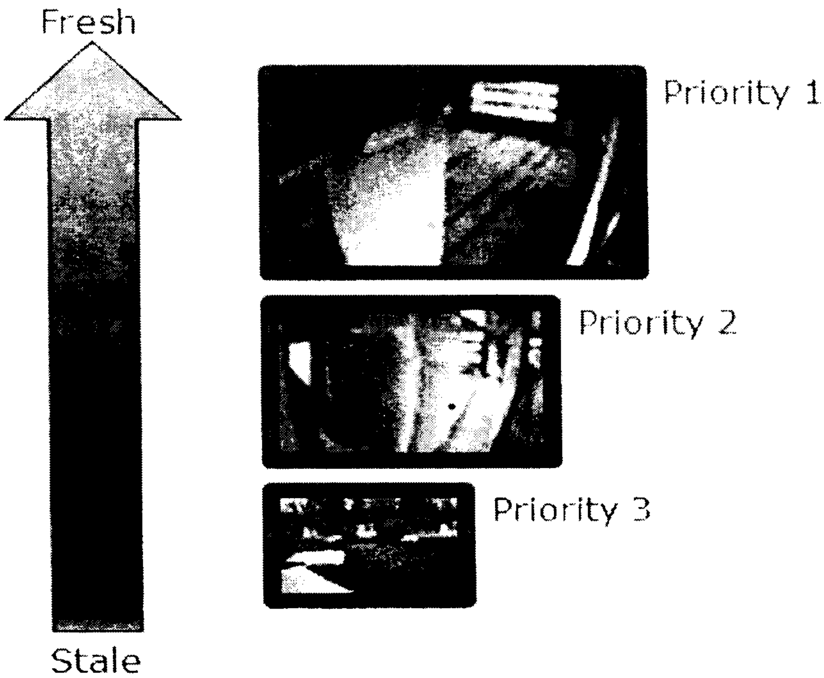


FIG. 12

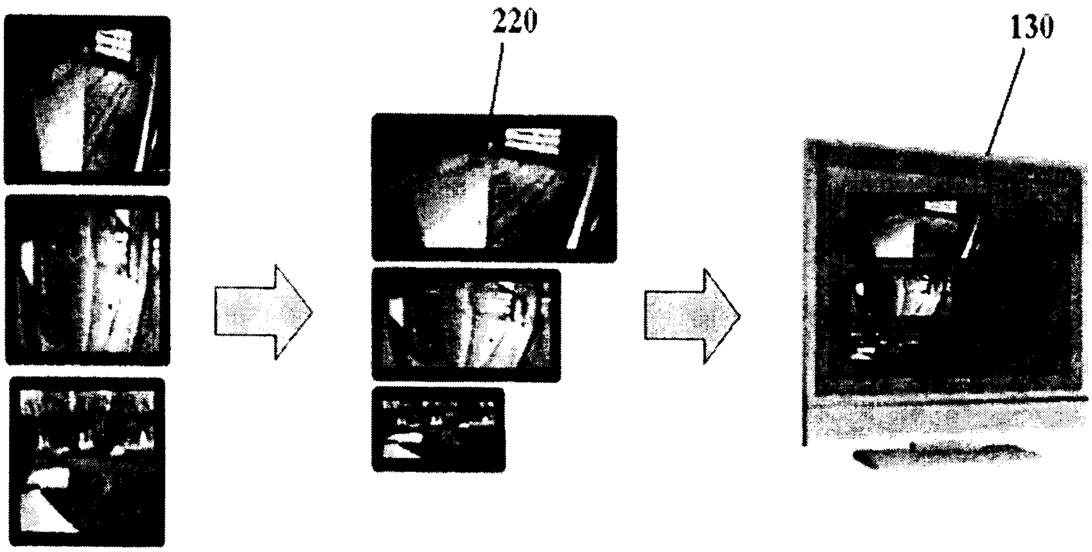


FIG. 13