TRAFFIC EVENT DETECTION METHOD AND SYSTEM

TTECHNICAL FIELD

[0001] The present disclosure relates to traffic event detection method and system.

BACKGROUND

[0002] Conventionally, in traffic event detection, a complex process generally is used to achieve identification of a traffic event. For example, in identification of a traffic event in a video, it requires a combination of theories and methods such as image processing, pattern recognition and machine learning or the like. For example, there are some techniques as follows: firstly, in-depth discussion on background initialization of a background model and background expression and updating is performed to achieve adaptive foreground motion region detection in a complex scene; a classification algorithm supporting a multi-class support vector machine is designed by using morphological characteristics as well as motion characteristics of a moving object to achieve category judgment on a mixed traffic moving object, and a multi-feature matching tracking algorithm based on Kalman filter and a method for handling occlusion based on history motion information compensation are proposed to ensure accurate estimation of a motion state in a complex occlusion condition; a multi-level motion mode learning method is proposed by considering spatial characteristics, direction characteristics and category characteristics of trajectories and then a abnormal behavior detection method is constructed based on Bayes spatial mode matching and origin-destination direction mode matching; particular concepts including simple event and complex event or the like are defined by using state attributes of a moving object and context-related information involved in the traffic scene to provide a general expression way for event identification; and on these bases, a basic event recognition method is built based on Bayes classifier in combination with logical constrains and a complex event recognition method is built based on hidden Markov model.

[0003] In addition, conventionally, for detection of an event in a video, a method for semantic-based detection of an event in a video is proposed. This method makes use of a general semantic representation to describe and express a traffic event reasonably, and then

uses a pattern recognition method to realize efficiently automatic recognition of an event. This method focuses on four key aspects: description and classification of identification features of multiple motion objects in a video, semantic-based complex event detection and analysis, semantic-based event correlation mining and high-level semantic description and understanding of event level, and proposes an adaptive feature description and classification method of multiple moving objects in combination of moment invariant quantities, a method for detecting and analyzing a complex event based on trajectories and multi-label hypergraph model, a algorithm for semantic-based event mining according to temporal association rules and a method for describing and understanding multi-thread events in a video based on a case grammar frame network structure.

SUMMARY

[0004] However, there are various problems in the above-described apparatus and method for traffic event detection.

[0005] First, there is a problem of high cost. In the real world, there are various kinds of traffic objects. In process of identification and classification, a large amount of features need to be selected to achieve relatively accurate and meticulous object classification. Further, a traffic object may have complex and diverse behaviors and randomness is strong, so it is necessary to collect a large number of trajectory samples to establish a reasonable and effective behavior mode learning model. Moreover, it is necessary to build a large-scale database that covers multiple types of video events, and to define event types and unify standards in order to develop research work related to semantic analysis of video contents.

[0006] In addition, there is a problem of complex structure. The effective identification of traffic events is closely related to context-related information of the traffic events. On the basis of analysis of an object's behaviors, it is necessary to strengthen intelligent identification of its context. A video file contains rich semantic information, so it is necessary to describe and extract multi-attribute features in the video and find out their relevance. It is necessary to study, after analyzing video semantics, standards for describing video semantics in a comprehensive, accurate and general manner.

[0007] Further, there is a problem of limited application. Under the current video detection technology, for night scene and rain and snow weather, the system cannot work steadily to perform identification and classification of moving objects, which results in its application is very limited.

[0008] Therefore, the present invention proposes a traffic event detection technique that can quickly determine a traffic event and is easy to use.

[0009] The present disclosure provides a traffic event detection method including: a motion state related quantity acquisition step of acquiring motion state related quantities of motion of feature points at each of a plurality of time points, the feature point representing a vehicle; an entropy calculation step of calculating, based on values of the acquired motion state related quantities at respective time points, entropy values of a traffic flow at respective time points; and a traffic event detection step of fitting the calculated entropy values of the traffic flow at respective time points with a predetermined time interval and determining whether or not there is a traffic event according to results of the fitting.

[0010] In the traffic event detection method described above, the entropy calculation step may further include: performing division of a plurality of status sections based on the values of the motion state related quantities; calculating a ratio of a number of feature points in each of the state sections with respect to a number of all feature points as a probability for the state section; and calculating the entropy value based on the probability.

[0011] In the traffic event detection method described above, the feature point may represent the vehicle itself, and the motion state quantity acquisition step further comprises acquiring the motion state quantities using a vehicle inspection device.

[0012] In the traffic event detection method described above, the feature point may represent corners of a vehicle in a video image, and the motion state quantity acquisition step further comprises acquiring, based on coordinates of the corners in video images at different time points, motion state related quantities reflecting motion of the corners at each time point.

[0013] In the traffic event detection method described above, the motion state related quantity may be any one or any combination of the following items: velocity magnitude of the feature points, velocity direction of the feature points, and acceleration of the feature points, position coordinate of the feature points.

[0014] In the traffic event detection method described above, the motion state related quantity may be a combination of velocity magnitude of the feature points and velocity direction of the feature points, and the entropy calculation step may further include: performing division of the state sections based on the velocity magnitude of the feature points and velocity direction of the feature points; calculating a ratio of a number of feature points in each of the state sections obtained based on the velocity magnitude of the feature points and velocity direction of the feature points with respect to all feature points as the probability for the state section.

[0015] In the traffic event detection method described above, in division of the state sections, the state sections may be divided evenly.

[0016] In the traffic event detection method described above, in division of the state sections, the state sections may be divided unevenly.

[0017] The traffic event detection method described above may further include: a corner detection step of detecting corners from pixels in the video image; and a corner tracking step of tracking motion of the corners using optical flow tracking, wherein the feature point represents corners of a vehicle.

[0018] In the traffic event detection method described above, the traffic event detection step may further include: calculating alarm level according to slope of each of the straight lines fitted from the entropy values; and taking start and end of a linearly fitted sliding window as starting and ending time of the alarm.

[0019] The present disclosure provides a traffic event detection system including: a motion state related quantity acquisition unit configured to acquire motion state related quantities of motion of feature points at each of a plurality time points, the feature point representing a vehicle; an entropy calculation unit configured to calculate, based on values of the acquired motion state related quantities at respective time points, entropy values of a traffic flow at respective time points; and a traffic event detection unit configured to fit the calculated entropy values of the traffic flow at respective time points with a predetermined time interval and determine whether or not there is a traffic event according to results of the fitting.

[0020] In the traffic event detection system described above, the entropy calculation unit may be further configured to: perform division of a plurality of status sections based on the

values of the motion state related quantities; calculate a ratio of a number of feature points in each of the state sections with respect to a number of all feature points as a probability for the state section; and calculate the entropy value based on the probability.

[0021] In the traffic event detection system described above, the feature point may represent the vehicle itself, and the motion state quantity acquisition unit may be further configured to acquire the motion state quantities using a vehicle inspection device.

[0022] In the traffic event detection system described above, the feature point may represent corners of a vehicle in an video image, and the motion state related quantity acquisition unit may be further configured to acquire, based on coordinates of the corners in video images at different time points, motion state related quantities reflecting movement of the corners at each time point.

[0023] In the traffic event detection system described above, the motion state related quantity may be any one or any combination of the following items: velocity magnitude of the feature points, velocity direction of the feature points, and acceleration of the feature points, position coordinate of the feature points.

[0024] In the traffic event detection system, the motion state related quantity may be a combination of velocity magnitude of the feature points and velocity direction of the feature points, and the entropy calculation unit may be configured to: perform division of the state sections based on the velocity magnitude of the feature points and velocity direction of the feature points; and calculate a ratio of a number of feature points in each of the state sections obtained based on the velocity magnitude of the feature points and velocity direction of the feature points with respect to all feature points as the probability for the state section.

[0025] In the traffic event detection system described above, in division of the state sections, the state sections may be divided evenly.

[0026] In the traffic event detection system described above, in division of the state sections, the state sections may be divided unevenly.

[0027] The traffic event detection system described above may further include: a corner detection unit configured to detect corners from pixels in the video image; and a corner tracking part configured to track motion of the corners using optical flow tracking, wherein the feature point represents corners of a vehicle.

[0028] In the traffic event detection system described above, the traffic event detection unit may be further configured to: calculate alarm level according to slope of each of the straight lines fitted from the entropy values; and take start and end of a linearly fitted sliding window as starting and ending time of the alarm.

[0029] The present disclosure provides a traffic event detection system comprising: a processor; a memory for storing instruction executable by the processor, wherein the processor is configured to: acquire motion state related quantities of motion of feature points at each of a plurality of time points, the feature point representing a vehicle; calculate, based on values of the acquired motion state related quantities at respective time points, entropy values of a traffic flow at respective time points; and fit the calculated entropy values of the traffic flow at respective time points with a predetermined time interval and determine whether or not there occurs a traffic event according to results of the fitting.

[0030] In the traffic event detection system, the processor may be further configured to perform division of a plurality of status sections based on the values of the motion state related quantities; calculate a ratio of a number of feature points in each of the state sections with respect to a number of all feature points as a probability for the state section; and calculate the entropy value based on the probability. The feature point may represent corners of a vehicle in a video image, and the processor may be further configured to acquire, based on coordinates of the corners in video images at different time points, motion state related quantities reflecting motion of the corners at each time point. The motion state related quantity may be any one or any combination of the following items: velocity magnitude of the feature points, velocity direction of the feature points, acceleration of the feature points, position coordinate of the feature points. The motion state related quantity may be a combination of velocity magnitude of the feature points and velocity direction of the feature points, and the processor may be further configured to: perform division of the state sections based on the velocity magnitude of the feature points and velocity direction of the feature points; calculate a ratio of a number of feature points in each of the state sections obtained based on the velocity magnitude of the feature points and velocity direction of the feature points with respect to all feature points as the probability for the state section. In division of the state sections, the state sections may be divided evenly. In division of the state sections,

the state sections may be divided unevenly. In the traffic event detection system, the processor may be further configured to detect corners from pixels in the video image; and track motion of the corners using optical flow tracking, wherein the feature point represents corners of a vehicle. The processor may be configured to calculate alarm level according to slope of a straight line fitted from the entropy values and take start and end of a linearly fitted sliding window as starting and ending time of the alarm.

[0031] The present disclosure provides a traffic event detection program, the program is able to enable a computer to perform the following operation: acquiring motion state related quantities of motion of feature points at each of a plurality of time points, the feature point representing a vehicle; calculating, based on values of the acquired motion state related quantities at respective time points, entropy values of a traffic flow at respective time points; and fitting the calculated entropy values of the traffic flow at respective time points with a predetermined time interval and determining whether or not there is a traffic event according to results of the fitting.

[0032] According to some embodiments, the present disclosure provides a storage medium having traffic event detection program stored thereon, the program is able to enable a computer to perform the following operations: acquiring motion state related quantities of motion of feature points at each of a plurality of time points, the feature point representing a vehicle; calculating, based on values of the acquired motion state related quantities at respective time points, entropy values of a traffic flow at respective time points; and fitting the calculated entropy values of the traffic flow at respective time points with a predetermined time interval and determining whether or not there is a traffic event according to results of the fitting.

[0033] According to the present disclosure, it is not necessary to select a large amount of video features, to realize accurate object classification and recognition, to acquire a large number of trajectory samples, to construct a complicated video event library, to intelligently identify context information of traffic events, and to build a rich semantic library. Using entropy values to detect traffic events reduces complexity of the system and reduces application costs. In addition, according to the present disclosure, macroscopic events (i.e., traffic events) can be detected by microscopic state (i.e., entropy) of the system.

[0034] In addition, in detection of traffic events in a video image, due to use of corners, it is able to perform traffic event detection well even if in night scene or rain and snow weather or the like because the corners are almost not affected by lighting conditions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035] Fig. 1 is a flow chart illustrating a traffic event detection method.

[0036] Fig. 2 is a diagram illustrating division of state sections based on velocity direction and velocity magnitude.

[0037] Fig. 3 is a graph illustrating entropy versus time according to an example.

[0038] Fig. 4 is a diagram illustrating fitting of the entropy values according to an example.

[0039] Fig. 5 is graph illustrating alarm level versus alarm time according to an example.

[0040] Fig. 6 is a flow chart illustrating a particular traffic event detection method.

[0041] Fig. 7 is a structural diagram illustrating a traffic event detection system.

[0042] Fig. 8 is a particular structural diagram illustrating a traffic event detection system.

[0043] Fig. 9A～9C are diagrams showing detection on traffic congestion, in which Fig.9A is a diagram showing detected corners, Fig.9B is a diagram showing variation in the entropy and Fig. 9C is a diagram showing variation in the alarm level over time.

[0044] Fig. 10 is a structural diagram illustrating a traffic event detection system.

DETAILED DESCRIPTION

[0045] Hereinafter, the present invention will be described in details with reference to the drawings.

[0046] Fig.1 is a flow chart showing a traffic event detection method. The method includes: acquiring motion state related quantities of motion of feature points at each of a plurality of time points, the feature point representing a vehicle; calculating, based on values of the acquired motion state related quantities at respective time points, entropy values of a traffic flow at respective time points; and fitting the calculated entropy values of the traffic flow at respective time points with a predetermined time interval and determining whether or not there is a traffic event according to results of the fitting. The traffic event here refers to an unusual event that makes the traffic change greatly in a short time. The traffic event has

distinct characteristics from a normal traffic flow, such as traffic accidents, traffic flow breakdown, and so on. Specifically, the traffic event may be traffic jams, collision between vehicles, hits to humans, abnormal velocity of vehicles, running parallel of vehicles, crashes to barriers, crashes to roadbeds, and so on. The sudden change in the entropy means that the traffic state is being changed suddenly, which in turn indicates that a new traffic event is being occurred.

[0047] First, as shown in step S1 of Fig. 1, motion state related quantities of vehicles are acquired. The motion state related quantities may include quantities related to velocity such as velocity magnitude, velocity direction, acceleration, position coordinates, or any combination thereof. The way to acquire the motion state related quantities of the vehicles can be obtained by means of the Internet of things such as a vehicle inspection device or by any other ways. The present disclosure is not particularly limited hereto, as long as it can be used for acquiring the motion state related quantities.

[0048] As shown in step S2 of Fig. 1, after the motion state quantities are acquired, the entropy is calculated based on the acquired motion state quantities.

[0049] Taking the motion state quantity referring to velocity field as an example, the entropy of the velocity field of the humans and the vehicles in a video is calculated. Fig.2 is a diagram illustrating division of state sections based on velocity direction and velocity magnitude. As shown in Fig. 2, assuming that the total number of vehicles to be tracked is N (i.e., the total number of particles is N) and the entropy value at this time point will be calculated based on velocity direction and velocity magnitude of each of the particles at the current time. The calculation process is as follows:

[0050] The velocity directions of the particles are divided into sections evenly, e.g. M sections from 0-360 degrees. The velocity magnitudes of the particles are divided into sections evenly, e.g. N sections.

[0051] The total number of state sections is calculated as C (M, N) = M * N.

[0052] Two-dimensional frequency H(i, j) (that is the number of particles falling into the state section Q_{i*j}) is calculated to obtain the number of particles falling into each of the divided state sections, wherein i is an integer greater than or equal to 1 but less than or equal to M, and j is an integer greater than or equal to 1 but less than or equal to N.

[0053] Two-dimensional map H (i, j) is drawn, as shown in Fig. 2. The lateral axis represents velocity magnitude, and the vertical axis represents velocity direction.

[0054] The probability P_{ij} for each of the state sections is calculated according to equation (1).

$$p_{ij} = \frac{H(i, j)}{N} \qquad (1)$$

[0055] The entropy value S at each time point is calculated according to equation (2).

$$S = -\sum_{i=1,j=1}^{C(M,N)} p_{ij} \log p_{ij} \qquad (2)$$

[0056] The entropy value is a sum of the probabilities of respective state sections multiplied by corresponding log values thereof.

[0057] Here, the motion state quantity is not limited to velocity of a vehicle, and it may be any quantity as long as it is able to reflect motion state of the vehicle. For example, the motion state quantity may be velocity magnitude of the vehicle only, the velocity direction of the vehicle only, or a combination thereof. In addition, the motion state quantity may be acceleration of the vehicle, and may be position coordinate of the vehicle.

[0058] In addition, in division of the state sections based on the motion state quantities, the state sections may be evenly divided, or may be unevenly divided.

[0059] By repeating the above steps, the entropy values at the time points can be calculated and plotted as a graph of the entropy values over time. Fig. 3 shows an example of a graph of entropy versus time. The lateral axis in Fig. 3 represents time and the vertical axis represents entropy. As shown in Fig. 3, the entropy value is low from the 1st time point to the10th time point, and the system is in an ordered state; and the entropy value increases from 11th time point to the 20th time point, and the system is in a disorder state.

[0060] As shown in step S3 of Fig. 1, the traffic event detection is performed using the entropy values calculated in the above-described step. A traffic event and traffic flow breakdown can be detected according to variation in the entropy values. The sudden change in the entropy values means that the traffic state is being changed, which in turn means that a new traffic event is being occurred.

[0061] The entropy values at all time points are fitted. Fig. 4 shows an example of linear fitting of the entropy values. Linear fitting is taken as an example to illustrate. For the calculated entropy values at all time points, the entropy values are linearly fitted at regular intervals (assuming 2 seconds). As shown in Fig. 4, a total number of 9 linear fittings are performed with respect to the line segments numbered as 1 to 9.

[0062] A alarm level is calculated according to slope of each of the line segments in the linear fitting shown above. The alarm level is slope of a fitted line divided by 90 degrees. The starting and ending time of the alarm is the start and end of the sliding window. As shown in Fig. 5, the lateral axis represents alarm time and the vertical axis represents alarm level. The alarm level at each time point is calculated according to slope of linear fitting of the entropy values.

[0063] In the process of obtaining the alarm level based on the entropy values, the present disclosure is not limited to linearly fitting of the entropy values, and any other way may be used as long as an alarm level can be obtained.

[0064] The present disclosure has been illustrated in embodiments described above, and can be applied to detect a traffic event in a video image. The specific way is as follows.

[0065] This is illustrated by taking a video image being detected to determine a traffic event for example. Here it focuses on use of corners to obtain the motion state quantities and then calculation of the entropy in the video image.

[0066] In an image, a corner may be a point where brightness of the two-dimensional image changes violently or a point of which curvature is the maximum on edge curves of the image. Corners are important local features that determine shape of a key area in the image. Corners are important feature information that has a decisive effect on determination of contour feature of an object. Once the contour feature of the object is found, the shape of the object is substantially grasped. Therefore, corners have very important significance in object recognition, image matching and image reconstruction.

[0067] In addition, because a corner has a characteristic of being unchanged during rotation, so it is almost not affected by lighting conditions. Thus, it plays a very important role in the field of computer vision such as in three-dimensional scene reconstruction, motion estimation, object tracking and recognition, and image registration and matching.

[0068] In a video image, a vehicle can be represented by its own plurality of corners. The corner of the vehicle may be, for example, a point at which two contour lines intersect. The detection and tracing of the vehicle can be simplified to detection and tracking of multiple corners of the vehicle. Based on the above described characteristics of the corners, it is able in traffic event detection to grasp important local features in the video image by using the detected corners, and thus avoid direct identification of the vehicles and humans. Representing a vehicle with its corners enables effective reduction of data amount while keeping important feature information, so that amount of calculation for the image processing is greatly reduced. Therefore, for a video image, a corner detection step is performed firstly in step S11 to obtain corners representing a vehicle, as shown in Fig. 6.

[0069] There are many ways to detect corners, and these ways generally can be divided into four categories: corner detection based on edge features, corner detection based on gray image, corner detection based on binary image, and corner detection based on mathematical morphology. The principle for corner detection may be interpreted in a most intuitive way as that: the corner is a point having large changes in any two mutually perpendicular directions.

[0070] Harris corner detection technology can be used to detect the corners. A Harris corner has characteristics of being unchanged under rotation.

[0071] As shown in step S12 of Fig. 6, optical flow tracking is performed for the detected corners.

[0072] An optical flow may be a sparse light flow or a dense light flow. Each pixel of a dense light flow is related to velocity or displacement. The Horn-Shrunk method and block matching method can be used as a method for tracking motion by using a dense optical flow. In the present disclosure, a sparse optical flow is used as an example. In the calculation, a set of points (corners) must be specified before tracking, and then a pyramid LK optical flow algorithm is used for the movement tracking.

[0073] As shown in step S13 of Fig. 6, motion state quantities of the corners are acquired. For two sequent video frames, assuming time t and t+1 and corner i has coordinate of $p_{it}(x, y)$ and $p_{i(t+1)}(x, y)$. The motion state quantities of the corner i are calculated based on time and coordinate of the corner. The motion state quantities are, for example, velocity of

the corner $v_i = p_{i(t+1)}(x, y) - p_{it}(x, y)$, wherein the velocity component in x direction is $v_{ix} = p_{i(t+1)}(x) - p_{it}(x)$, and the velocity component in y direction is $v_{iy} = p_{i(t+1)}(y) - p_{it}(y)$.

[0074] As shown in step S14 of Fig. 6, after the motion state quantities are acquired, the entropy is calculated based on the acquired motion state quantities. Taking the motion state quantity referring to velocity field as an example, the entropy of the velocity field of the humans and the vehicles in a video is calculated. Steps S14 and S15 of Fig. 6 are the same as those of steps S2 and S3 in Fig. 1 for the first embodiment except that corners are used to replace the vehicle in the first embodiment, and therefore the descriptions will not be repeated.

[0075] Fig. 7 shows a structural diagram of a traffic event detection system. The traffic event detection system 1 shown in Fig. 7 includes a motion state quantity acquisition unit 11, an entropy calculation unit 12, and a traffic event detection unit 13.

[0076] The motion state quantity acquisition unit 11 acquires motion state related quantities of motion of feature points at each of a plurality time points, the feature point representing a vehicle. The entropy value calculation unit 12 calculates, based on values of the acquired motion state related quantities at respective time points, entropy values of a traffic flow at respective time points. The traffic event detecting unit 13 fits the calculated entropy values of the traffic flow at respective time points with a predetermined time interval and determine whether or not there is a traffic event according to results of the fitting.

[0077] The entropy calculation unit 12 performs division of a plurality of status sections based on the values of the motion state related quantities, calculates a ratio of a number of feature points in each of the state sections with respect to a number of all feature points as a probability for the state section; and calculates the entropy value based on the probability.

[0078] The feature point may represent the vehicle itself. The motion state quantity acquisition unit 11 may acquire the motion state quantities by a vehicle inspection device. The feature point may represent corners of a vehicle in the video image. The motion state quantity acquisition unit 11 acquires, based on coordinates of the corners in video images at different time points, motion state related quantities reflecting movement of the corners at each time point.

[0079] The motion state quantity may be any one or any combination of the following items: velocity magnitude of the feature points, velocity direction of the feature points, acceleration of the feature points, position coordinate of the feature points.

[0080] In a case that the motion state related quantity is a combination of velocity magnitude of the feature points and velocity direction of the feature points, the entropy calculation unit 12 perform division of the state sections based on the velocity magnitude of the feature points and velocity direction of the feature points, and calculates a ratio of a number of feature points in each of the state sections obtained based on the velocity magnitude of the feature points and velocity direction of the feature points with respect to all feature points as the probability for the state section.

[0081] In addition, in division of the state sections, the state sections may be divided evenly, or may be divided unevenly.

[0082] The traffic event detecting unit 25 calculates alarm level based on slope of each of the straight lines linearly fitted from the entropy values, and the start and end of the linearly fitted sliding window may be taken as starting and ending time of the alarm.

[0083] The traffic event detection system according to the present disclosure can perform calculation of motion state quantities of vehicles in a video image using corners of the vehicles, as shown in Fig. 8.

[0084] The traffic event detection system shown in Fig. 8 may further includes: a corner detection unit 21 that detects corners from pixels in the video image, and a corner tracking unit 22 that tracks motion of the corners using optical flow tracking, wherein the feature point representing corners of a vehicle. The traffic event detection system 20 of Fig. 8 uses corner detection and tracking to obtain motion state quantities of the corners. For example, coordinates of the corners and the corresponding time can be used to calculate velocity of the corners. After motion state quantities of the corners are acquired, the same processes as those in Fig. 7 are performed. The entropy calculation unit 24 and the traffic event detection unit 25 have the same functions as the entropy calculation unit 12 and the traffic event detection unit 13 of the traffic event detection system 10, which is not repeated here.

[0085] Application Example 1

[0086] Referring to Figs. 9A to 9C, detection of traffic congestion is described. Fig. 9A is a diagram showing detected corners (the circles in the figure denote the corners), Fig. 9B is a graph showing variation of the entropy values versus time, and Fig. 9C is a diagram showing variation of the alarm level versus time.

[0087] The traffic event detection method and system according to the present invention can be used in the following applications: real-time detection of traffic events for detecting early warned traffic events; real-time warning of traffic events for predicting further traffic trends according to real-time calculation of a entropy trend chart and providing warning of traffic accidents to be occurred; and real-time alarming of traffic events for providing an alarm according to real-time calculation of change in the entropy values, wherein alarm level is in proportion to change of the entropy values, and the bigger the change is, the higher the alarm level is.

[0088] According to the above descriptions, the present invention is able to provide a traffic event detection method and a system that can quickly determine a traffic event and are easy to use.

[0089] The various component embodiments of the present invention may be implemented in hardware, or in software modules executed on one or more processors, or by firmware in which a program is programmed, or in a combination thereof. It should be understood by those skilled in the art that Fig. 10 is a block diagram of a traffic event detection system, which may be a workstation. For example, the traffic event detection system includes a bus 409 which is connected to each of components as follows. The system includes a processor 405. The processor 405 is a very large scale integrated circuit, and is a computing core and control core of a computer. Its main function is to interpret computer instructions and process data in computer software. The processor 405 mainly includes an operator and a cache memory 406 and a bus that implements data, control, and status communication therebetween.

[0090] The processor 405 is configured to: acquire motion state related quantities of motion of feature points at each of a plurality of time points, the feature point representing a vehicle; calculate, based on values of the acquired motion state related quantities at respective time points, entropy values of a traffic flow at respective time points; and fit the calculated entropy

values of the traffic flow at respective time points with a predetermined time interval and determine whether or not there is a traffic event according to results of the fitting.

[0091] The processor 405 is further configured to: perform division of a plurality of status sections based on the values of the motion state related quantities; calculate a ratio of a number of feature points in each of the state sections with respect to a number of all feature points as a probability for the state section; and calculate the entropy value based on the probability. The feature point may represent corners of a vehicle in a video image, and the processor 405 may be configured to acquire, based on coordinates of the corners in video images at different time points, motion state related quantities reflecting motion of the corners at each time point. The motion state related quantity may be any one or any combination of the following items: velocity magnitude of the feature points, velocity direction of the feature points, acceleration of the feature points, and position coordinate of the feature points. The motion state quantity may be a combination of magnitude of velocity of the feature point and direction of velocity of the feature point, and the processor 405 is further configured to: perform division of the state sections based on the velocity magnitude of the feature points and velocity direction of the feature points; calculate a ratio of a number of feature points in each of the state sections obtained based on the velocity magnitude of the feature points and velocity direction of the feature points with respect to all feature points as the probability for the state section. In division of the state sections, the state sections may be divided evenly. In division of the state sections, the state sections may be divided unevenly. In the traffic event detection system, the processor 405 may be further configured to detect corners from pixels in the video image, and track motion of the corners using optical flow tracking, wherein the feature point represents corners of a vehicle. The processor is able to calculate alarm level according to slope of each of the straight lines fitted from the entropy values and take start and end of a linearly fitted sliding window as starting and ending time of the alarm.

[0092] The traffic event detection system may also include a memory. The storage devices in a computer may include a main memory (memory) such as ROM (Read Only Memory) 403 and RAM (Random Access Memory) 404 and an auxiliary memory (external memory) 402. The memory has a storage space for executing program codes of any of the method steps

in the above methods. For example, the storage space for the program codes may include individual program codes for implementing the various steps in the above methods, respectively. The program codes can be read from one or more computer program products or written into one or more computer program products. These computer program products include program code carriers such as hard disks, optical disks (CDs), memory cards, or floppy disks. Such computer program products are typically portable or fixed storage units. The storage unit may have a storage section, a storage space, and the like arranged in a similar manner to the memory in the terminal described above. The program codes may, for example, be compressed in an appropriate form. Typically, the storage unit includes computer readable codes, i.e. codes that can be read by a processor and causes, when executed by the processor, the processor to perform the various steps in the method described above.

[0093] Further, the traffic event detection system includes at least one input device 401 for interaction between a user and the traffic event detection system. The input device 401 may be a keyboard, a mouse, an image capture element, a gravity sensor, a sound receiving element, a touch screen or the like. The traffic event detection system may also include at least one output device 408, which may be a speaker, a buzzer, a flash, an image projection unit, a vibration output element, a screen or a touch screen, and the like. The traffic event detection system may also include a communication interface 407 for performing data communication in a wired or wireless manner.

[0094] A number of specific details are set forth in the descriptions provided herein. However, it will be understood that embodiments of the present invention may be practiced without these specific details. In some embodiments, well-known methods, structures, and techniques have not been shown in detail so as not to obscure the understanding of this specification.

[0095] It is to be noted that the above-described embodiments illustrate the invention and are not to be construed as limiting of the invention, and that one skilled in the art may designate alternative embodiments without departing from the scope of the appended claims. The word “comprise” does not exclude the presence of elements or steps not listed in the claims. The word “a” or “an” before an element does not exclude the presence of a plurality

of such elements. The present invention may be implemented by means of hardware comprising several different elements and by means of a suitably programmed computer. In the claims enumerating several device units, several of these device units may be embodied by a same hardware item. The use of the words such as first, second, and third does not indicate any order. These words can be interpreted as names.

[0096] In addition, it should also be noted that the language used in this specification is chosen primarily for the purpose of readability and teaching, and is not selected for the purpose of explaining or defining the subject matter of the present invention. Accordingly, many modifications and variations will be apparent to those of ordinary skill in the art without departing from the scope and spirit of the appended claims. Regarding scope of the invention, the disclosures are intended to be illustrative and not restrictive, and the scope of the invention is defined by the appended claims.

[0097] The above-described embodiments are merely illustrative of the technical concepts and features of the present invention and are intended to enable those skilled in the art to understand the invention and practice it, but not intended to limit the scope of the present invention. Any equivalent alterations or modifications made in accordance with the spirit of the invention are intended to be included within the scope of the present invention.

[0098] While the embodiments of the present invention have been described with reference to the accompanying drawings, those skilled in the art will be able to make various modifications and variations without departing from the spirit and scope of the invention, such modifications and variations are all within the scope of the invention as defined by the claims.

WHAT IS CLAIMED IS:

1. A traffic event detection method, comprising:

a motion state related quantity acquisition step of acquiring motion state related quantities of motion of feature points at each of a plurality of time points, the feature point representing a vehicle;

an entropy calculation step of calculating, based on values of the acquired motion state related quantities at respective time points, entropy values of a traffic flow at respective time points; and

a traffic event detection step of fitting the calculated entropy values of the traffic flow at respective time points with a predetermined time interval and determining whether or not there is a traffic event according to results of the fitting,

wherein the entropy calculation step further comprises:

performing division of a plurality of status sections based on the values of the motion state related quantities;

calculating a ratio of a number of feature points in each of the state sections with respect to a number of all feature points as a probability for the state section; and

calculating the entropy value by multiplying the probability by a log value of the probability.

2. The traffic event detection method of claim 1, wherein

the feature point represents corners of the vehicle in a video image; and

the motion state related quantity acquisition step further comprises acquiring, based on coordinates of the corners in video images at different time points, motion state related quantities reflecting motion of the corners at each time point.

3. The traffic event detection method of any one of claims 1 to 2, wherein

the motion state related quantity is any one or any combination of the following items: velocity magnitude of the feature points, velocity direction of the feature points, acceleration of the feature points, position coordinate of the feature points.

4. The traffic event detection method of any one of claims 1 to 2, wherein the motion state related quantity is a combination of velocity magnitude of the feature points and velocity direction of the feature points, and

the entropy calculation step further comprises:

performing division of the state sections based on the velocity magnitude of the feature points and velocity direction of the feature points;

calculating a ratio of a number of feature points in each of the state sections obtained based on the velocity magnitude of the feature points and velocity direction of the feature points with respect to all feature points as the probability for the state section.

5. A traffic event detection system, comprising:

a motion state related quantity acquisition unit configured to acquire motion state related quantities of motion of feature points at each of a plurality time points, the feature point representing a vehicle;

an entropy calculation unit configured to calculate, based on values of the acquired motion state related quantities at respective time points, entropy values of a traffic flow at respective time points; and

a traffic event detection unit configured to fit the calculated entropy values of the traffic flow at respective time points with a predetermined time interval and determine whether or not there is a traffic event according to results of the fitting,

wherein the entropy calculation unit is further configured to:

perform division of a plurality of status sections based on the values of the motion state related quantities;

calculate a ratio of a number of feature points in each of the state sections with respect to a number of all feature points as a probability for the state section; and

calculate the entropy value by multiplying the probability by a log value of the probability.

6. The traffic event detection system of claim 5, wherein

the feature point represents corners of the vehicle in an video image; and

the motion state related quantity acquisition unit is further configured to acquire, based on coordinates of the corners in video images at different time points, motion state related quantities reflecting movement of the corners at each time point.

7. The traffic event detection system of any one of claims 5 to 6, wherein

the motion state related quantity is any one or any combination of the following items: velocity magnitude of the feature points, velocity direction of the feature points, acceleration of the feature points, position coordinate of the feature points.

8. The traffic event detection system of any one of claims 5 to 6, wherein the motion state related quantity is a combination of velocity magnitude of the feature points and velocity direction of the feature points, and

the entropy calculation unit is further configured to:

perform division of the state sections based on the velocity magnitude of the feature points and velocity direction of the feature points;

calculate a ratio of a number of feature points in each of the state sections obtained based on the velocity magnitude of the feature points and velocity direction of the feature points with respect to all feature points as the probability for the state section.

9. A traffic event detection apparatus, comprising:

a processor;

a memory for storing instructions executable by the processor,

wherein the processor is configured to perform:

a motion state related quantity acquisition step of acquiring motion state related quantities of motion of feature points at each of a plurality of time points, the feature point representing a vehicle;

an entropy calculation step of calculating, based on values of the acquired motion state related quantities at respective time points, entropy values of a traffic flow at respective time points; and

a traffic event detection step of fitting the calculated entropy values of the traffic flow at respective time points with a predetermined time interval and determining whether or not there is a traffic event according to results of the fitting,

wherein the entropy calculation step further comprises:

performing division of a plurality of status sections based on the values of the motion state related quantities;

calculating a ratio of a number of feature points in each of the state sections with respect to a number of all feature points as a probability for the state section; and

calculating the entropy value by multiplying the probability by a log value of the probability.

10. A computer readable storage medium having instructions stored thereon, the instructions, when executed by a device, cause the device to perform a traffic event detection method according to any of the claims 1-4.