Event Detection at Vehicle Location Points using Spatial Time Invariant Model

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Abstract—**The localization and recognition of moving objects from single monocular intensity images has been a popular issue in image analysis and computer vision over many years. It is also one of the fundamental crisis in model based vehicle localization and recognition. The recently used scheme is model based on simple object recognition and localization of road vehicles using the position and orientation of vehicle image data. But the drawback of the approach is that the shape of the vehicle and its pose varies in multiple junction coordination, the model based recognition is an inefficient one. To overcome the issues, our first work implemented a surveillance image object recognition and localization using improved local gradient model. The vehicle-object shape recognition and pose recovery in the traffic junction is carried out for varied traffic densities. But the drawback of the approach is that it considers only the vehicle shape and pose variations in the road network and does not discuss about the occurrences of event at the vehicle junction points. Now we have to focus on the process of occurrences of event like accident met at traffic junctions. For this, in this work, spatial time invariant model is introduced to measure the event occurrences of the vehicle traffic location points. The event which has been takes place is recorded as the reference context for standardization of the traffic modality. With the reference context, the detector can easily find out the reason of the event takes place. An experimental evaluation is carried out to estimate the performance of the proposed event detection at vehicle location points using spatial time invariant model (EDSTIM) in terms of spatial events, multiple time scales, traffic controlling time and compared with an existing model based on simple object recognition and localization and the previous work Surveillance of Vehicle Object Recognition and Localization.**

Keyword-Vehicle object recognition, object localisation, spatial time invariant model, reference context, traffic modality

I. INTRODUCTION

The major principle of vehicle discovery was to determine the number of vehicles at every intellection position for flow inference and calculation. Consequently, point-oriented sensors, i.e., ultrasonic sensors or circle detectors, have been frequently utilized. In recent times, image-processing sensors have turn out to be virtually obtainable in ITS applications. Not only can those sensors determine the number of vehicles but they also determine swiftness; they also contain the prospective to perceive traffic accidents. The process of identifying the occurrence of spatial events is described in Fig. 1.

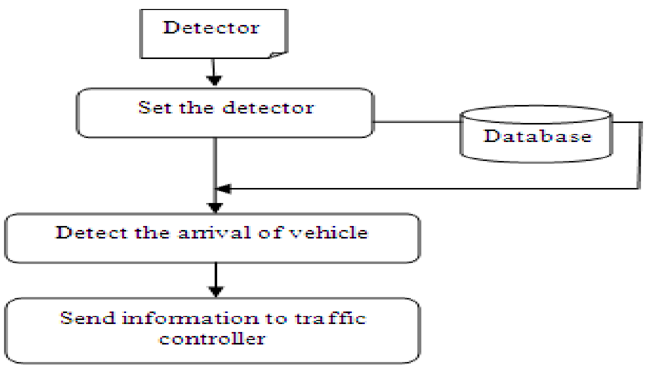

Fig. 1. Process of occurrence of spatial events

The Traffic organizer which is an online processor will constantly supervise the traffic. The traffic organizer must be associated to the detectors. The detector will accumulate the information concerning the detector positions, substantial arrangement of the road network and how the traffic signals manage the entity traffic torrents. Any adaptive traffic organization system relies ahead good recognition of the present circumstances in real-time to permit a rapid and efficient reaction to any transforms in the present traffic condition. Detectors are usually essential on each connection.

To facilitate record and examine non trivial actions in road passage scenes we contain to deal with the subsequent problem: Either we must consume the camera on an fascinating manager by pertaining gape control so that the negotiator ruins in the ground of view. Or we should exercise a motionless camera with a meadow of vision that is huge enough to confine considerable actions of affecting agents. The instantaneous deficiency of the submissive approach is enclosed by the protuberance of the affecting agent. Image province signs like gray value edges and corners are diminutive and can be barely noticed. In addition, in a road passage prospect, extremely jumbled atmosphere full of locale features with occlusions and dis-occlusions cope up with the traffic control scenes. This leaves the assignment of unfairness tremendously complex. The exercise of models representing a priori acquaintance emerges required so as to achieve the inflexible job of noticing and tracking beneath genuine world conditions.

In this work, spatial time invariant model is introduced to measure the event occurrences of the vehicle traffic location points. The event which has been takes place are recorded as the reference context for standardization of the traffic modality. With the reference context, the detector can easily find out the reason of the event takes place.

II. LITERATURE REVIEW

One of the main troubles met in huge cities is to facilitate of traffic jamming. Numerous measures had been organized to deal with the crisis of road traffic jamming in huge cities that is between these are: the production of flyovers and bypass roads, forming circle roads, redeployment of traffic custodians to mess spots and creation of conservative traffic light supported on counters.

The paper [1] explained research knowledge of constructing a bright system to observe and organize road traffic. A mixture method attained by the voyage of the prearranged Systems examination and devise method (SSADM) and the Fuzzy-Logic based devise method was organized to expand and realize the system.

Event discovery is a challenging assignment in vehicular networks for a range of real-world requests. Many genuine globe actions frequently display composite spatio-temporal prototypes whereby they marked themselves through annotations over time and space proximities. These spatio-temporal actions cannot be switched well by a lot of the earlier methods. Geographic Information System (GIS) is considered to toil with data referenced by spatial organization. The system proposed in [2] thinks on forming the ontology and shipping out the comments. It performed traffic examination and emphasize the diverse traffic zones. But the method does not propose alternating path so that users can be abstracted to diverse routes.

In [3], suggest a novel Spatio-Temporal Event Detection (STED) algorithm in networks supported on a active provisional arbitrary field (DCRF) representation. But STED technique assembled with the indecision of sensor data clearly. In [4], proposed a UML representation for an Adaptive Road Traffic organization system which presents a method for calculating the traffic in road network employing signals that are routinely proscribed by detectors.

The series could conclude all road cases with diverse conditions based on the flow of images, which are mined from the video cameras [5]. A structure for an active and habitual traffic light power expert system was planned by [6]. The representation accepted inter-arrival time and inter-departure time to simulate the arrival and leaving number of cars on roads. Using GPS information [8], the paper in [7] showed how long a vehicle can remain on the road and N represents the number of lanes.

In recent years, research on event detection in vehicular networks [10] has received much interest. The author in [9] presented pattern based approach to find out the event on the traffic junction board by consuming more time to detect. A 3-D deformable vehicle model is used based on the location on the traffic junction boards and its direction about the perpendicular axis underground-plane restraints [11]. For stationary vehicles, many geometric models can be employed to discover vehicles, which have been well recapitulated in [12].

To overcome the issues met with the event detection at different traffic junction boards, in this work, spatial time invariant model is introduced to measure the event occurrences of the vehicle traffic location points. The event which has been takes place are recorded as the reference context for standardization of the traffic modality. With the reference context, the detector can easily find out the reason of the event takes place.

III. PROPOSED EVENT DETECTION AT VEHICLE LOCATION POINTS USING SPATIAL TIME INVARIANT MODEL

The research work is efficiently designed for detecting the events occurring at the traffic junction boards by adapting the spatial time invariant model. The occurring events at traffic junction boards are recorded as a reference context in the standardization of the traffic modality. The proposed event detection at vehicle location points using spatial time invariant model is processed under two different phases. The first phase is to describe the process of identifying the events happening at the traffic junction boards with spatial time invariant model.

The second phase describes the process of reference context of the events through which the detector will easily identify the reason of events takes place at the particular junction points. The architecture diagram of the proposed event detection at vehicle location points using spatial time invariant model is shown in Fig. 2.

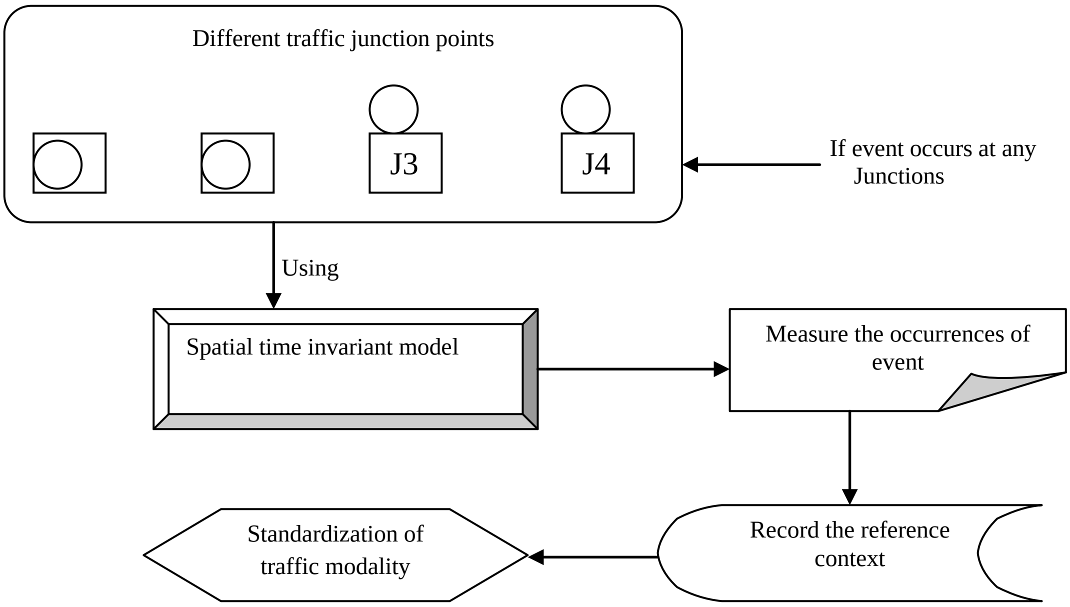

Fig. 2. Architecture diagram of the proposed EDSTIM

The first phase describes the process of identifying the events happening at the traffic junction boards with spatial time invariant model. Based on the events occurring at the traffic junctions, the traffic controller will manage the vehicles at the traffic junction points. With the camera fixed on the traffic junction board, a detector will analyze how and when the event takes place efficiently in a simple manner. The second phase describes the process of reference context of the events through which the detector will easily identify the reason of events takes place at the particular junction points

In road network, different traffic junction points are there to control the traffic. At each junction points, there is a camera to be fixed to know about the vehicle densities and traffic rate at the road network. If any events like accident or misbehaviours done by the people at the side, it is necessary for the traffic controller to control the traffic at right time. To identify the event at right place, the spatial time invariant model id adopted for sensing the occurrences of events at traffic junction points. The events happening at the junction points are recorded as reference context for the standardization of traffic modalities.

A. Spatial Time Invariant Model for Event Detection

Generally, space time invariant model is represented as a numerical depiction that merges space and time into a distinct range. Space-time is generally inferred with space as being three-dimensional and time acts as the position of a fourth dimension that is of a diverse type from the spatial dimensions.

Space-times are the fields in which all substantial actions take place—an event is a place in space-time précised by its time and position. The primary component of space-time is events. In every specified space-time, an occurrence of event is an exclusive position at a distinctive time. Since events are space-time points, an instance of an occurrence of incident is expressed as (x, y, z, t), the location of a simple (point-like) element at a scrupulous time. A space-time itself can be analyzed as the combination of all actions in the similar way that a procession is the combination of all of its points. A space which can be explained at diminutive scales by means of coordinates systems.

In a Euclidean space, the partition among two events is considered by the distance among the two points. A distance is merely spatial. In space-time, the partition among two events is considered by the invariant period among the two events, which captures into account not only the spatial partition among the events, but also their sequential partition. The period among two events is expressed as:

$$s^2 = \Delta r^2 - c^2 \Delta t^2 \quad (1)$$

Where c is the speed of vehicle, and Δr and Δt indicate variations of the space and time management, correspondingly, among the events. The space-time interval between two events is defined as

$$\Delta s^2 \equiv -(\Delta t)^2 + (\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2 \quad (2)$$

and that the relation between this interval as measured by two vehicles O_1 and O_2 is

$$\Delta s_2^2 = f(v)\Delta s_1^2 \quad (3)$$

Where $f(v)$ is some function which may possibly depend on v, the rapidity of O_2 relative to O_1. In this post we desire to illustrate that in fact f=1 so that the period among two events is an authentic invariant that is the identical to all spectators.

B. Example scenario

To begin, suppose that O_2 is moving at speed v along the direction x1 axis of O_1 and that the origins of the two systems coincide as usual. O_1 Places at some traffic junction points of length 2a at rest along the traffic junction board of y_1-axis (so it is perpendicular to the direction of O_2 's motion), with the midpoint of the traffic junction at y_1=0, so the junction point extends to $y_1 = \pm a$. (We'll ignore the constituent at this time; because all the deeds take lay in two spatial dimensions.) Let event A is one end of the traffic junction point at $t_1 = x_1 = 0, y_1 = -a$ and event B is the other end of the traffic junction point at $t_1 = x_1 = 0, y_1 = +a$. Clearly the two processes are simultaneous to O_1, and therefore the square of the length of the traffic junction boards as measured by O_1 is $\Delta s_1^2(AB) = (\Delta y_1)^2 = (2a)^2$, the interval between events A and B.

Now suppose O_2 performs a similar trial to that which we used to determine the location of O_2 's x_2-axis in O_1 's frame. That is, at time t_2=-a, O_2 identifies two forms of event, one in the direction of the $+y_2$ axis, and the other in the direction of the $-y_2$ axis. Since the speed of the vehicle is c=1, these two events will takes place at a distance a in the time from t_2 = -a to t_2=0, so they will arrive at the endpoints of the traffic junction boards at t_2=0. But since the origins of the two frames coincide, O_2 is at the origin just as the two events reach the endpoints of the traffic junction. If there are mirrors at the endpoints of the vehicles, then the events will be identified soon and will take time for the vehicles a to travel back to O_2, so vehicles arrive at the same event, with coordinates $t_2 = +a, x_2 = y_2 = 0$. Since the vehicles travel the same distance of a and they both arrive at the same time, they must have started out at the same time. That is, events A and B, as seen by both O_1 and O_2 are simultaneous, as they occur at t=0 in both frames.

Two events that occur at the same time have $\Delta t = 0$ so this means that the interval $\Delta s^2(AB)$ must be

$$\Delta s^2(AB) = (\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2 \quad (4)$$

In other words, the interval in both events measures the time taken by the vehicle in each traffic junction, and we get

$$(length)_2^2 = f(v)(length)_1^2 \quad (5)$$

According to the first postulate of relativity (Galileo's postulate), there are no 'special' directions in space, so provided we keep the orientation of the vehicle perpendicular to the direction of camera, the actual direction of the vehicles cannot matter. For example, if we went through the same analysis with O_2 moving in any direction that is perpendicular to the direction of the traffic junction board, we would come to the same conclusion. So this function f(v) must depend (if it depends on v at all) only on the magnitude of the vehicle speed and not its direction:

$$F(V) = f(v) \quad (6)$$

Nevertheless, from the primary alteration $(length)_2^2 = f(v)(length)_1^2$ we have to get f (v) = +1, as both the squares must be positive. So we arrive at possibly the most fundamental result in special relativity: the interval Δs^2 between two events is an invariant, having the similar value in all inertial edges.

IV. Experimental Evaluation

The proposed event detection at vehicle location points using spatial time invariant model is efficiently designed and implemented in Java to measure the event occurrences of the vehicle traffic location points and recorded as the reference context for standardization of the traffic modality. At first set up, the surveillance images are captured based on the position, location, angular view of the images using ray traced scheme. Then the vehicle object recognition and the localization are identified using the improved gradient model which exactly identifies the vehicles drag on the traffic phase. After that, spatial time invariant model is being used to identify the occurrence of events, if any, takes place. If any event occurred, it is recorded as a reference context for further identification. The performance of the proposed event detection at vehicle location points using spatial time invariant model is measured in terms of spatial events detection.

V. Results and Discussions

In this work, we have seen how the occurrence of events is detected efficiently using spatial time invariant model. The vehicle-object shape recognition and pose recovery are already obtained using improved gradient model in the traffic junction is carried out for varied traffic densities. Compared to an existing model based on simple object recognition [MOR] and localization and EVORL, the proposed event detection at vehicle location points using spatial time invariant model obtained an efficient event detection process by analyzing the events happening at the traffic junction boards. The below table and graph describes the performance of the proposed event detection at vehicle location points using spatial time invariant model.

TABLE I
Vehicles density vs. spatial event detection rate

Vehicles Density	Spatial Event Detection Rate		
	Proposed EDSTIM	EVORL	MOR
10	23	20	18
20	34	25	23
30	48	31	27
40	54	35	33
50	60	38	35

The table (TABLE I) describes the spatial event detection rate based on the number of vehicles met at the traffic junction points. The spatial event detection rate of the proposed event detection at vehicle location points using spatial time invariant model is compared with an existing model based on simple object recognition [MOR] and localization and EVORL.

Fig. 3. Describes the spatial event detection rate based on the number of vehicles met at the traffic junction points. At each traffic junction points, there might be some events to be occurred. Based on the occurrences of event, the proposed spatial time invariant model is efficiently applied. The events which are happened recorded invariant to time and acts as a reference context to the detector to identify the reason of event occurrences. By which, the events are easily monitored and processed. In the previous work EVORL, only the vehicle in the traffic junction board are positioned and analysed, does not discuss the event detection process. In existing model based on simple object recognition, the process focused only about the vehicle object recognition.

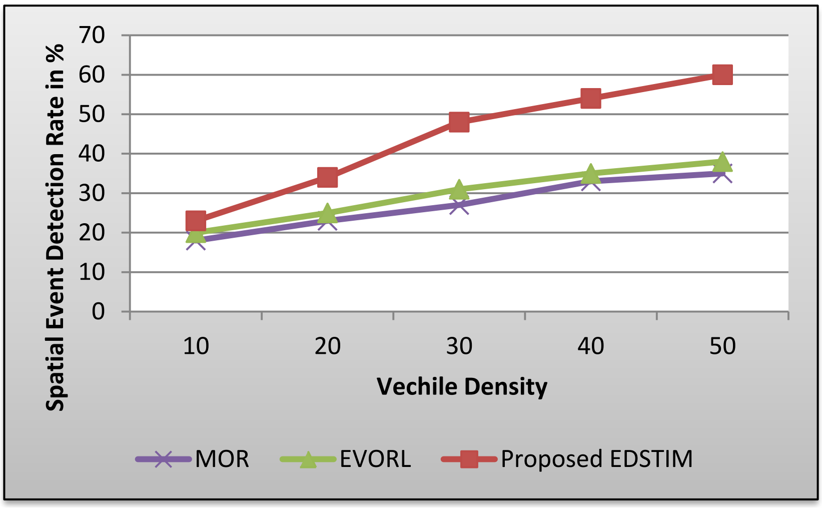

Fig. 3. Vehicles density vs. spatial event detection rate

Compared to an existing model based on simple object recognition [MOR] and localization and EVORL, the proposed event detection rate based on the number of vehicles met at the traffic junction points provides an efficient spatial event detection rate even when vehicle densities are high. The variance in spatial event detection rate is 40-50% high in the proposed EDSTIM.

VI. CONCLUSION

In this paper, we have proposed a spatial time invariant model to the representation of spatial information regarding the traffic junction boards. The vital initiative is to indulge spatial relations as event types. This approach is efficiently processed according to any hurdles owing to spatial changes in one or more of the connected objects, with providing the benefits of the spatial event-cantered approach, particularly with respect to vehicle densities and occurrences of event. Model based on simple object recognition [MOR] and localization and EVORL, the proposed spatial time invariant model efficiently done the event detection at vehicle localization points. An experimental evaluation showed that the proposed EDSTIM provides an efficient detection rate at a minimal interval of time. The proposed event detection at vehicle location points using spatial time invariant model consumes 50% less detection time to identify the events and the efficiency of controlling the traffic is 65% high compared to an existing model based on simple object recognition [MOR] and localization and EVORL.

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