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VPEDA: A Robust Vantage Point Based Event Detection Architecture for Efficient Object Detection and Localization

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Abstract: Currently the identification and localization of mobile objects have come as one of the most important approaches for event detection on road. VANET applications works on the principle of local gradient method that evaluates the fitness between projection of the vehicle model and object data. However, the mobile objects are highly susceptible to the appearance of the vehicle and displacement that changes at a frequent time period. In VANET, each mobile object broadcasts its unique id, the appearance and displacement in beacon packets. The appearance and displacement are the two important factors to be considered during event detection. For that purpose, the traffic scenarios in road network have to be monitored at different perspectives to notice the location information of mobile objects. This study put forwards a Vantage Point-based Event Driven Architecture (VPEDA) as a novel method to get insight into different levels of events during different time periods. Furthermore, Object identification and position forecast using local gradient method considers only the exterior of the vehicle and displacement in the road network and does not discuss about the occurrences of event at the vehicle junction points. The proposed VPEDA focuses on the event detection using the different neighbourhood information of the mobile objects during diversified time interval using a vantage point. VPEDA process the occurrences of event like accident met at traffic junctions during different interval of time. The located event at a particular vantage point identifies the neighbour mobile object that is taken as the nodal point for standardization of the traffic modality. Moreover, with the nodal point, the locator ensures that the reason behind the event to be identified in an early stage. An investigational assessment is carried out to analyse the impact of the vantage point on average vehicle speed, percentage of packets delivered and. Experimental results shows that VPEDA can detect the event which involve the different number of mobile objects with minimum delay.

Key words: Object identification, object localization, vanet, vantage point, nodal point, gradient, appearance, displacement, event detection, traffic modality

INTRODUCTION

Series of image examines the consequences of different events in prospect. A similar mechanism to support higher level metaphors in addition with the consequences of the objects being affected has been explained. With the deployment of three-dimensional models the way in which the objects are arranged and movement of the corresponding objects are identified. In this way, the routes of the vehicles are identified on the basis of the movement of affecting objects and also on the assumptions of the objects in an iterative manner.

The principle behind vehicle detection was to identify the number of vehicles at different positional (using map direction model) matrix to infer the flow of the vehicle and to evaluate it accordingly. Different types of sensor have been used by different researcher to detect the event in an efficient way ranging from point-oriented sensors, ultrasonic sensors. With the adaptation of sensors, number of vehicles in movement are not only identified but also identifies the swiftness that supports to predict the probable accidents. The occurrence of time factor is an important issue to be addressed. The process of identifying the occurrence of events is described in Fig. 1.

Figure 1 shows the process of occurrence of events with the event being detected is sliced using thick red lines. The job of the detector is to collect the information regarding the position of detector, event

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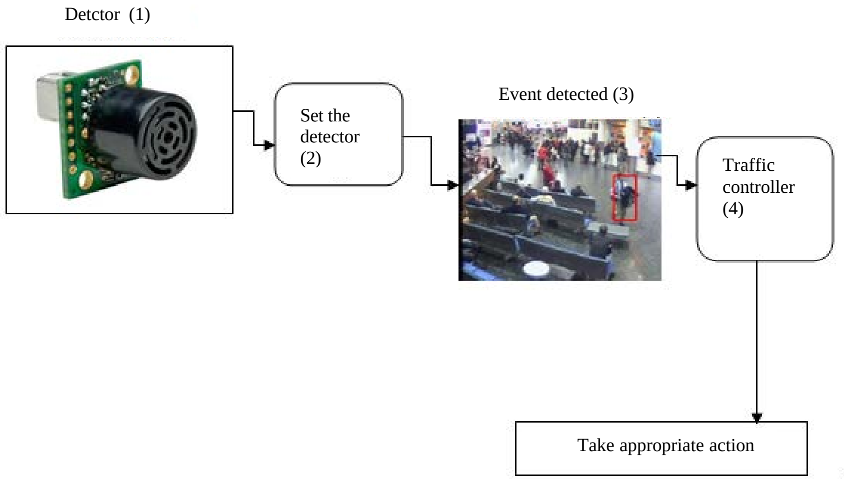

Fig. 1: Process of occurrence of spatial events

being detected typical configuration of the road networks and so on. Once the detector is set, the event detected is identified with additional parameters such as the event, the entry time of event and so on. Traffic controller which is an online processor regularly supervises the traffic or the event being detected and captured using the detectors.

The contribution of this study is novel Vantage Point-based Event Detection (VPEDA) for efficient object recognition and localization using neighbourhood search algorithm. Motivated from the work, Localization and Recognition of road vehicles using Local Gradient (LRLG) method, we design the vehicle vantage points using time neighbourhood model. However, unlike the conventional vehicle localization and recognition that monitors the vehicle on the basis of time, we use a directed graph model where the vertices represent the actual vehicle and the edges represent the road segment. The time neighbourhood model for each vehicle measures the occurrences of event based on the time and the neighbourhood events. With the neighbourhood events, they are further recorded as the nodal points for standardization of the vehicles in VANET. With the nodal point, the locator easily identifies the occurrence of the event. This study explores the above mentioned techniques and combines them together to provide a collection of time and neighborhood scheme in VANET.

Literature review: One of the foremost problems related to VANET are to avoid congestions in many metros due to higher traffic jams and have to emphasize a smooth traffic flow. Many measures have been taken to avoid the problem of road traffic jamming in different congested cities by ensuring accident-free zones, by constructing ECR roads, flyovers and bypass roads, forming circle roads, redeployment of traffic custodians to mess spots and creation of conservative traffic light supported on counters. Jiang *et al*. (2011) explained the methodologies involved in designing a novel mechanism to measure and accordingly organize road traffic. An aggregate method was utilized consisting of the prearranged Systems Examination and Devise Method (SSADM) and the Fuzzy-Logic based devise method was organized to increase the size of the network and design the system accordingly to provide smooth flow of traffic.

Event discovery is one of the significant tasks involved in the vehicular networks for a range of real-world requests. Different genuine globe actions frequently display aggregate spatio-temporal prototypes whereby they use the network model measures in different time intervals observed over different time period and space proximities. These spatio-temporal actions cannot be applied to various vehicle models using the early mechanisms due to the different types of shapes, sizes involved in vehicles. Geographic Information System (GIS) is considered as one of the data to measure the even using the spatial organization.

The method presented by Wolf and Heipke (2007) uses the formation of ontology and addressed the measures related to GIS by giving suitable solutions. It performed traffic examination and emphasize the diverse traffic zones. But the main flaw using GIS-based model was that it did not provide alternate path so that the vehicles can follow and forward their packets through the diversified routes. Zu Kim and Sengupta (2008) presented novel Spatio-Temporal Event Detection (STED) algorithm was presented that used and worked on an active provisional arbitrary field (DCRF) representation. But STED algorithm did not concentrated on the problem related to the indecision of sensor data clearly. Li *et al*.

(2009) presents a UML representation was presented for an Adaptive Road Traffic organization system which provided a method for measuring the traffic in road network by constructing different signals that are routinely provided by the detectors.

Mechanisms provided Deutscher and Reid (2005) provided for different road scenarios under different circumstances followed set of conditions that were mined from the video cameras. A traffic light expert power system Zhang *et al.* (2012) planned and structured accordingly that was designed on the basis of the inter-arrival time and inter-departure time to emulate the entering and exiting of the vehicles on roads was designed with GPS information as explained by Zhang *et al.* (2010). A configuration with the number of vehicles to wait in the road under different number of lances Zhang *et al.* (2008a, b) designed in a predetermined manner.

Event localization and detected received much interest among different researchers. A pattern based approach Zhang *et al.* (2008ab); Farah *et al.* (2008) designed to identify the event on traffic junction board that consumed more time to detect. The location of the traffic junction boards were used with 3-D deformable vehicle model Zhang *et al.* (2012) identified the direction about the perpendicular axis underground-plane restraints. Elaborate research works were carried out using different types of geometric models deployed by observing the location of the stationary vehicles.

Beacon messages were used by Zhu and Bamles (2011) for vehicular environment with the help of broadcast algorithm that was highly significant for sparse range of vehicles that employed the local information. The information included in the beacon messages were the details regarding the acknowledgement of the message broadcasted instantly. Additionally, the author also used the connected dominated set to identify which the vehicle to a connected dominating set without using time-out expiration. The mechanism also provided and gave solutions to the problem of propagation at road intersections with less latency and increase in vehicle model remained to be unaddressed.

Due to the security aspects to be covered in vehicular ad hoc network, the network model has received greater attention. At the same time, the privacy was also the main concern from the side of the users that were uncovered. A state of the art including the threat model in addition to the security aspects were being addressed with the basic secure VANET components. The Game-theory framework of Wang *et al.* (2006) solved the security aspects of VANETs that used optimized methods using defensive mechanisms where the malicious attackers get into the system with higher level of threats being introduced. The game-theory framework used the centrality measures as input by mapping the centrality values of vehicle based on the road topology with the analysis for different scenarios were not solved in an extensive manner.

A design model was presented for Ommer and Buhmanns (2010) covered the security aspect which was structured on the basis of cryptographic mechanism with the plausibility identification with the help of neighbor discovery in a secured manner and also addressed the problems related to the mobility issues. Additionally, Geocast addressed also the software-based prototype design for VANET in a secured manner. But the major defect in Geocast was that it resulted in a comparatively lesser network performance under realistic VANET scenarios.

This variation tends to decrease the network performance in VANET. Here, we extend this approach by measuring the detection of events based on the vantage point that serves as a nodal point to measure the occurrences of event in VANET. Moreover, the work measures the mobile object at different time intervals using the neighborhood information and presented the extended evaluation results, assessing not only the detection of events but also observe the event detection at different time intervals. In summary, the contributions are:

- To provide novel Vantage Point-based Event Detection Architecture (VPEDA) for efficient object recognition and localization using neighbourhood search algorithm
- Present Vantage Point-based Event Driven Architecture (VPEDA) for neighbour information position using map direction model for event detection and localization observed during different time periods
- Focuses on the event detection with neighbourhood information of the mobile objects during different timestamp using vantage point

Vantage point based event detection architecture: In this study, the network model for neighbor information positioning in VANET with the description about it is presented with the help of an architecture diagram followed by the vantage point-based event detection. Next the two phases involved in designing vantage point-based event detection and vantage point-based event-driven architecture is presented.

The traffic detection at vehicle location points using the neighbourhood information of mobile objects is deployed under two different phases. The first phase identifies the possible position of the neighbour mobile objects at different time period using a Vehicle Detection algorithm (VD-NI) with Neighbour Information Model.

The second phase identifies the nodal point which serves as the reference to measure the occurrences of the events through which the locator identifies the reason for events at the particular junction points. The architecture diagram of the vantage point-based event detection for efficient object recognition and localization using neighbour information model is shown in Fig. 2. Figure 2 illustrates the architecture diagram of vantage point-based event detection using neighbour information model. Initially, different traffic junction points are observed. If the event occurs at any junctions, neighbour information model is applied. Using neighbour information model, the occurrences of events are measured. Based on the occurrences of events, the vantage point is measured that denotes the occurrence of event. With the vantage point as the base and neighbor information model, the neighbour mobile objects are identified and referred to as the nodal points. Using nodal points as standardization of traffic modality, the locator propagates the occurrences of events to other mobile objects.

Network model for neighbor information positioning in vanet: The neighbor information techniques were presented for WSNs. The neighbor information positioning in VANET uses the distance between the neighbor nodes in VANET. In order to achieve neighbor information positioning in VANET two parts of information have to be acquired. They are (i) possible position of the neighbor mobile objects and (ii) identifying the nodal point. The typical vehicular scenario to be observed in VANET is shown in Fig. 3.

Figure 3 illustrates the typical event detection and localization in VANET. The mechanism of vantage point-based event detection architecture is designed efficiently for detecting the mobile objects at the traffic junction boards by dapting the neighbourhood information of mobile objects in VANET. As shown in the Fig. 3, the event being detected in x, thus, a mobile object, (e.g., mobile object x in Fig. 3) extract GPS positions of its neighbors p, q, r and s (with Dist(p,x), Dist(q,x), Dist(r,x), Dist(s,x). With the help of vantage point located at different locations, the neighbour mobile object based on the distance is taken as the nodal point for standardization of the traffic modality. The neighboring information of mobile object regarding the distance between the mobile object is extracted based on the timestamp.

Identifying Neighbor Mobile Objects: The first phase involved in VPEDA is that it identifies the position (called the vantage point) of the neighbour mobile objects at different time period using a Vehicle Detection algorithm (VD-NI) with Neighbour Information model. The process starts with the identification of the events happening at the traffic junction boards with neighbor information model. Based on the events occurring at different traffic junctions boards, the locator manages the vehicles at the traffic junction points. With the sensor devices fixed on the traffic junction board, the locator analyses how and when the event takes place efficiently in a simple manner.

The network model using neighbor mobile objects is represented using a directed graph model, vertices denoted by the mobile objects in road network, the edges being denoted as the road segment. The directed graph model for event detection is denoted as G = {V, E} where V = {V1, V2,...,Vn} and E = {E1, E2,..., Em} which is represented using matrix M as follows in Fig 4a.

Figure 4a shows the matrix representation of graphic model and Fig. 4b the actual happening of event using two points called as the vantage point and the nodal point. The vantage point is where the actual event

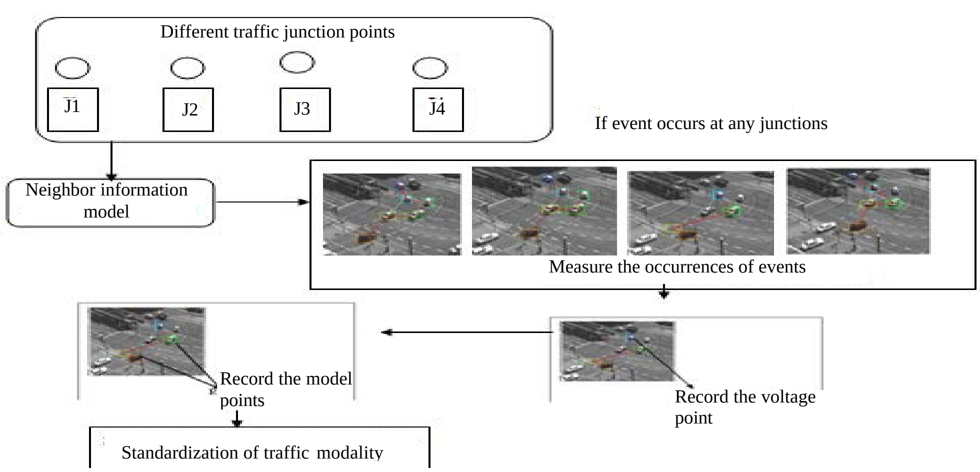

Fig. 2: Architecture diagram of vantage point based event detection

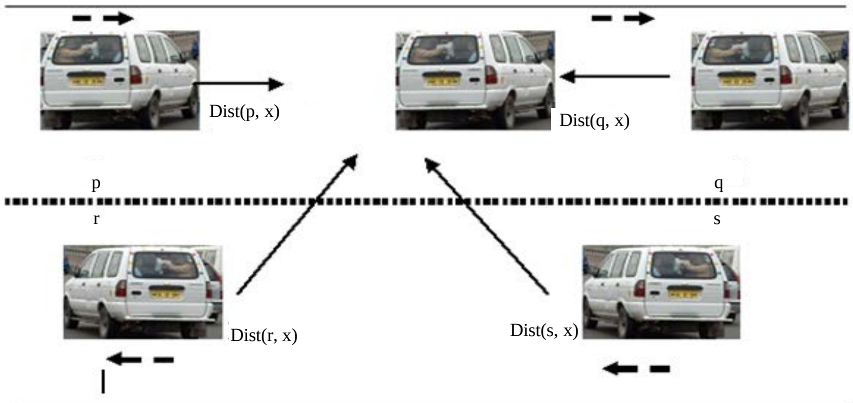

Fig. 3: Typical event detection and localization in VANET

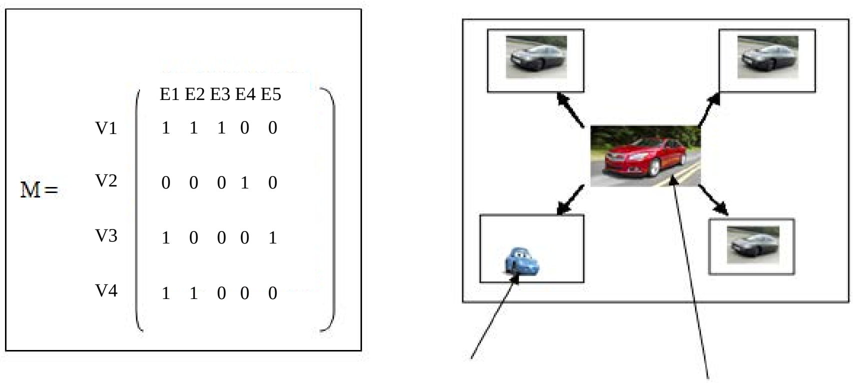

Fig. 4: Identifying neighbor mobile objects (a) Matrix representation of graphic model (b) Mobile objected detected

takes place. Using the neighbor information model, the distance of the neighbor mobile object is measured to identify the minimum distance between the event being detected and the neighbor mobile object. The neighbor mobile object having the minimum distance is marked as the nodal point.

Figure 5 shows the neighbor information model of detected vehicle denoted as Vx with the neighboring vehicles Vp, Vq, Vr and Vs. The vehicle is detected using unique particle filter. For each detected vehicle, the distance of neighbor mobile object Disti is detected at timestamp T as shown in Fig. 3 and 4. Additionally, an additive motion model for observing vehicle dynamics at various time intervals is measured. Initially, event being detected also called as the vantage point is identified. Then the neighbor information of the mobile object, the distance between the vantage point and the other mobile objects are collected using the timestamp T. With the orientation of vehicle is perturbed slightly then the closest distance to the vantage point is identified and the vehicle changes that moves forward according to the velocity, then the orientation is slightly changed accordingly.

In VANET, different traffic junction points are designed in order to control the traffic. At each junction point, a sensor is fixed to measure the vehicle densities and traffic rate at the road network. If any event or malicious activities happens to occur, the traffic locator locates the location of event (vantage point) at the appropriate time. To identify the event at right place, the neighbor information model is adopted for sensing the occurrences of events at traffic junction points. The events happening at the junction points are recorded as nodal point which is used as the reference context for the standardization of traffic modalities.

Map direction model for event detection: To complete the vehicle detection process, map direction model is designed. Given a vehicle's pose VP and the scan observed an event x, the map direction model for event detection p(x/VP) is computed as given below.

$$MP(x / VP) = \pi\left(\frac{x_i}{VP}\right) \quad \text{where } i = 1, 2, 3, 4 \qquad (1)$$

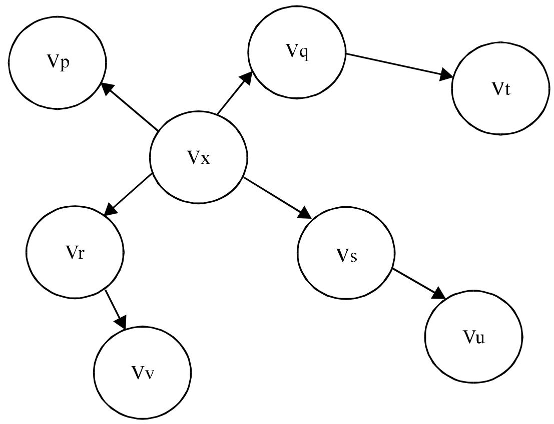

Fig. 5: Neighbor information model of detected vehicle Vx

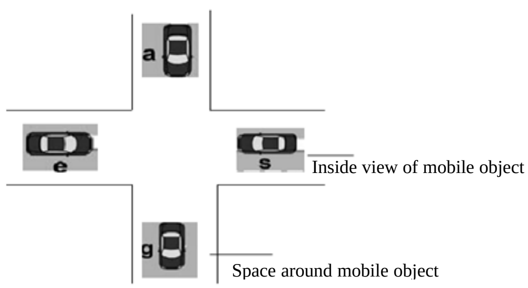

Fig. 6: Geometric regions for mobile object map direction detection model

MP(x/VP)denotes the map direction model to event x with the VP vehicle's pose VP and i =1, 2, 3, 4 denotes the map directions, east, west, north and south respectively. The mobile object is positioned inside the rectangular area denoting the VP.

Figure 6, shown the geometric regions for mobile object map direction model constructed in a rectangular area that include all mobile objects under consideration within a predefined distance threshold around the vehicle. With the assumption that there exists an actual vehicle in this directed graph model, the process is continued within the rectangle to be considered. Neighbor Information Model for Event Detection.

Neighbor information model for event detection: Neighbor information model for event detection and localization is represented as a numerical depiction that initially finds the vantage point. The neighbor information of the vantage point is identified by the locator and the neighboring mobile object is called as the nodal point. With the nodal point as a reference, the locator identifies the event in an early stage in such a way that the other neighboring mobile objects remain unaffected. The primary component of neighbor information model being the occurrence of event being detected at a distinctive time. As the detected events space time points, an instance of an occurrence of incident is expressed as (VP, V_p, V_t) , representing the vehicle pose obtained with a particular velocity with the vehicle position denoting east, west, north and south observed at a scrupulous time. A neighbor information model event detection is analysed as the combination of all actions in the similar way that a process is the mixture of all of its data points.

The neighbor information model for vehicle detection and localization uses the Euclidean distance between two mobile objects, one being the mobile object detected and the other being the neighbor mobile object. A partition between two events is evaluated using the Euclidean distance between the two mobile objects. The period between two events is expressed as:

$$S^2 = \Delta r^2 - c^2 \Delta t^2 \tag{2}$$

Where c is the speed of vehicle and Δr and Δt indicate variations of the distance and time between two events. The neighbor information model between two mobile objects is defined as:

$$\Delta S^2 = -(\Delta t^2) + (\Delta x^2) + (\Delta y^2) + (\Delta z^2) \tag{3}$$

and that the relation between the interval is measured for two vehicles pose VP1and VP2 is:

$$S_2^2 = f(VP) \Delta S_1^2 \tag{4}$$

Where f (VP) is a function which depend on V with the distance of two vehicles pose VP1 and VP2. To begin with if the vehicle V2 is moving at speed V along the direction x1 axis of VP1 and that the origins of the two systems coincide as usual. Let event x, called as vantage point denote one end of the traffic junction point at: t1 = x1 = 0, y1=-a and event B is denote the other end of the traffic junction point at t1 = x1 = 0, y1 = +a. Here, S_2^2 denotes the vantage point and S_1^2 denotes the nodal point. With the nodal point being observed, the locator further localizes the event and sends messages to the other neighboring mobile objects until all the mobile objects are informed.

Input the road junction number for a directed graph model (say DG1)
Let the vertices denoted by the vehicles in road network be V = {V1, V2,…,Vn}
Let the road segments incident on V and edges being denoted as E = {E1, E2,...,Em}

Let j = 1, Total connection = 0
Repeat
Spot and monitor the vehicle image entity recognition and forecasting position
Get the number of vehicles (Vi) on road E on the junction J1
Apply neighbor information model
Total connection = Total connection + Vi
Measure the event occurrences of vehicle traffic location points
Occurrence of event is noted as the vantage point
Obtain the vantage points neighbor mobile object
Occurrence of event near the vantage point is recorded as nodal points
Let i = i + 1
Monitor the events and clear the traffic efficiently
Until (for all traffic location points)
End

From the above Fig. 6 it is being noted that the process of measuring the event occurrences of the vehicle traffic location points efficiently done using neighbour information model. Once the event has been detected based on the vehicle density, it is referred as the vantage point. Based on the vantage point, the neighbor mobile object are detected which then acts as the nodal point for other objects in vicinity.

The retrieval framework: The proposed event detection at vehicle location points using neighbour information is well designed and executed 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, pointed analysis of the images using ray traced scheme. Then the vehicle object identification and the position forecast are identified using the enhanced grade design which exactly identifies the vehicles drag on the traffic phase. After that, neighbor information model is being used to identify the occurrence of events. If any event occurred, it is recorded as the vantage point. The vantage point acts as a reference context for further identification. The performance of the proposed event detection at vehicle location points using neighbor information model is measured in terms of Neighbor event detection rate, Neighbor event detection time and Traffic controlling time.

RESULTS AND DISCUSSION

Here, the perception is to view how the occurrence of events is detected efficiently using neighbor information design. The vehicle-object shape identification and pose revival are already obtained using improved gradient model in the traffic intersection is passed out for diverse traffic densities. Evaluating to a conventional design based on simple object identification (MOR) and position forecasting and EVORL, the planned event detection at vehicle location points using neighbor information model obtained an efficient event detection process by analysing the events happening at the traffic junction boards. The table given below and the graph describe the performance of the proposed event detection at vehicle location points using neighbor information model.

Table 1: Measure of neighbor event detectionrrate

	Neighbor event detection rate (cpm)	
Traffic density (veh/km)	Proposed VPEDA	Existing LRLG
10	25	18
20	38	25
30	45	30
40	59	40
50	65	48

Table 2: Measure of neighbor event detection time

	Neighbor event detection rate (cpm)	
Traffic density (veh/km)	Proposed VPEDA	Existing LRLG
10	15	30
20	30	38
30	24	42
40	35	50
50	40	55

Table 1 describes the neighbor event detection rate based on the traffic density observed at the traffic junction points. The neighbor event detection rate is measured in terms of counts per minute (cpm). VPEDA is compared with the existing design based on position forecasting and identification of road vehicles using Local Gradient (LRLG) method.

Figure 7 describes the neighbor event detection rate measured in terms of counts per minute based on the traffic density observed at the traffic junction points. At each traffic junction points, there is a possibility for the occurrence of certain events. Based on the occurrences of event, the neighbor information model is applied in an efficient manner. The vantage point being recorded at particular timestamp acts as a reference point to the locator who then identifies the neighbor object which then acts as the nodal point through which, the events are easily monitored and processed. In the existing work LRLG, only the vehicle in the traffic junction board are positioned and analysed, with the pose being initialized does not discuss the event detection process. In conventional design based on plain object identification, the process focused only about the vehicle object recognition. Compared to the existing design based on position forecast and identification of road vehicles using Local Gradient (LRLG), the event detection rate using NI is based on the number of vehicles met at the traffic junction points and the neighbor of the vantage point being considered. This in turn provides an efficient neighbor event detection rate even when traffic densities are high. The variance in neighbor event detection rate is 30-35% high in the VPEDA.

Table 2 describes the neighbor event detection time consumption observed for varying traffic density which is measured in milliseconds at the traffic junction points.

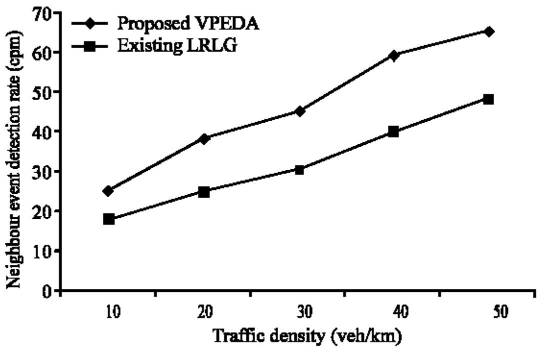

Fig. 7: Traffic density vs spatial event detection rate

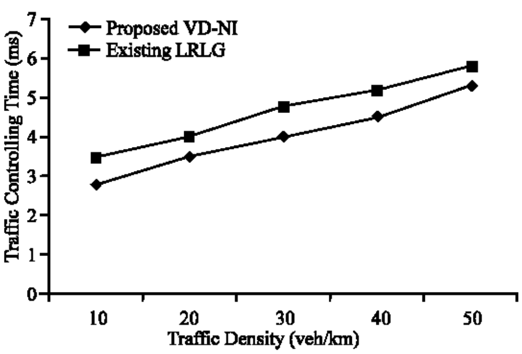

Fig. 8: Traffic density vs. Neighbor Event detection time

The neighbor event detection time consumption of the proposed event detection at vehicle location points using neighbor information model is evaluated with the prevailing design based on Localization and identification of road vehicles using Local Gradient (LRLG).

Figure 8 describes the neighbor event detection time consumption observed at differing traffic density with the traffic junction points. The neighbor event detection time is the time taken to detect the distinct event at a particular interval of time. In VPEDA, the event detection is identified with the neighbor information model. Compared to the existing model based on position forecasting and identification of road vehicles using Local Gradient (LRLG), the event detection rate using NI is based on the number of vehicles met at the traffic junction points consumes less event detection time for different traffic density. This is because of the application of separate vantage point and nodal point. The even being called the vantage point observes the nieghbor and propagates the information. The neighbor object called as vantage point propagates the information to their neighbours, with the even being detected at comparatively lesser interval of time. The variance in the consumption of neighbor event detection is 40-45% low in the VPEDA. Table 3 describes the traffic controlling time at the rate of different traffic density ranging from 10-50veh/km. The traffic controlling time at vehicle location points using neighbor information model is compared with the existing design based on position forecast and identification of road vehicles using Local Gradient (LRLG).

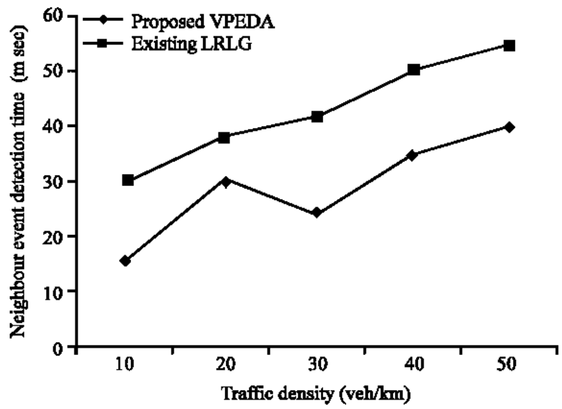

Fig. 9: Traffic density vs traffic controlling time

Table 3: Measure of traffic controlling time

	Neighbor event detection rate (cpm)	
Traffic density (veh/km)	Proposed VPEDA	Existing LRLG
10	2.8	3.5
20	3.5	4.0
30	4.0	4.8
40	4.5	5.2
50	5.3	5.8

Figure 9 describes the vehicle traffic controlling time based on the traffic densities at different traffic junction points. In VPEDA, the events happened at the junction boards are cleared very soon by the locator by adapting Euclidean distance of neighbor information model in addition to map direction model. So, the traffic controlling time consumes less and provides a road clear for the way out. Compared to the existing design based on position forecast and identification of road vehicles using Local Gradient (LRLG), the event detection rate based on the number of vehicles met at the traffic junction points consumes less traffic controlling time for different traffic densities. The variance in the traffic controlling time is 35-45% low in the VPEDA.

Ultimately, it is being experimented that the planned work well obtains understandable surveillance images using neighbourhood detection algorithm using the neighbor information model. Neighbor information model is introduced to efficiently measure the event occurrences of the vehicle traffic location points, called the vantage points, using which the nieghbors are measured, called as the nodal points and recorded as the reference context for standardization of the traffic modality by the locator.

CONCLUSION

The VD-NI algorithm was motivated by our interest in measuring the event occurrences of the vehicle traffic location points and the need for an algorithm which can accomplish the task based on neighbor information model. Neighbor information model is presented for representing the neighboring information of the mobile object using the map direction model using the trafic junction boards. An obvious potential of the algorithm VPEDA is, owing to changes in the neighboring mobile object in one or more of the connected objects provides the benefits of neighbor event-centred approach with respect to vehicle densities and occurrences of event. The results presented show that the algorithm is able to achieve comparatively better performance to the design based on position forecast and identification of road vehicles using Local Gradient (LRLG). Comparison with the LRLG on each of the vehicles density being observed suggest that VPEDA using the vantage point and nodal point, detected the event at minimal interval of time with traffic controlling time being 35-40% less without sacrificing the performance with the increased vehicle density. At the same time, VPEDA, vehicle location points using neighbor information model consumes 50% less detection time to identify the events and the efficiency of controlling the traffic is 65% high compared to the existing model LRLG.

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