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# Automatic Traffic Monitoring System Using Lane Centre Edges

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***Abstract: -*** *Robust and reliable traffic monitoring system is an urgent need to improve traffic control and management. Vehicle flow detection appears to be an important part in traffic monitoring system. The traffic flow shows the traffic state in fixed time interval and helps to control the traffic. This paper proposes an automatic traffic monitoring system which is used for estimating the important traffic parameters from video sequences through vision based cameras, and also used to detect the traffic flow in different lanes. Mainly this paper tells that how to detect the lanes and vehicle centres in different frames. This is used to count the number of vehicles in different lanes based on lane width.*

***Keywords: -*** *Traffic monitoring system, video processing, frame difference, Noise removal, Vehicle flow detection, lanes detection, edge detection, traffic parameters*

## I. INTRODUCTION

AN INTELLIGENT transportation system (ITS) is the application that incorporates electronic, computer, and communication technologies into vehicles and roadways for monitoring traffic conditions, reducing congestion, enhancing mobility, and so on. To achieve these goals, in past decades, there have been many approaches proposed for tackling related problems in ITS . Nowadays, there is an urgent need for the robust and reliable traffic surveillance system to improve traffic control and management with the problem of urban congestion spreads. Many traffic state parameters can be detected through traffic surveillance system, including traffic flow density, the length of queue, average traffic speed and total vehicle in fixed time interval. To achieve these goals, in past decades,

there have been many approaches proposed for tackling related problems. Among them, the vision-based approach

has the advantages of easy maintenance and high flexibility in traffic monitoring and, thus, becomes one of the most popular techniques used in traffic surveillance system.

During past Decades there are different types of traffic flow detection methods like background subtraction, frame subtraction, edge detection land mark based method.

Background subtraction techniques are mostly used for detection of motion in many real-time vehicle detection and tracking applications. In these approaches, difference between the future frame and the constructed background image is performed to detect foreground objects. But the problem is that it is extremely sensitive to dynamic scene changes due to lighting and extraneous events. Frames subtraction methods employ a threshold technique over the inter-frame difference, where pixel differences or block difference (in order to increase robustness) has considered. These techniques utilize the double difference on two or more successive frames to detect a ROI. The advantage of these methods is that it's an adaptive method. The major problem of these techniques is that it depends too much on the time interval of selecting the successive frames and the velocity of the vehicle. Land mark method makes a mark on the road. And the traffic is detected if the mark is covered. This method is robustness to the illumination and shadows. However, it is not allowed to make mark on the road. So it is not realistic. Edge detection is another effective method for traffic detection. Even under different condition of illumination, the edges can also be detected. So, the combination with edge detection method and frame difference method can reduce the drawbacks occur in background subtraction methods.

In This paper firstly we will take the traffic video and frames conversion will be done. After conversion background image was taken and frame difference operation will be applied to different frames. Then last frame will be only lane with noise, so we have to remove those noise .Next we will find the vehicle centers and lane center edges. Finally we will count the number of vehicles in lanes this vehicle counting will be based on lane width.

## II . OVERVIEW OF THE PROPOSED SYSTEM

Here for vehicle flow detection in lanes we will do the below process as shown in below figure. Mainly our aim is to detect the lane centers and number of vehicles in lanes. The traffic video is the input. All the processing will be done to the video. We can estimate the vehicle flow density in lanes. By estimating the vehicle flow detection we can control the traffic .These will come under the traffic parameters estimation. The traffic video is taken from internet and the video processing will be done. Frame difference, edge detection and background subtraction ,all these are some methods to detect the vehicles even in illumination conditions.

In this part, we will illustrate our traffic flow detection method in detail, including the background image information, vehicle centers and lane centers, vehicle counting method.

This frame difference subtraction detects the foreground objects as the difference between current frame and background frame. In general equation will be as follows:

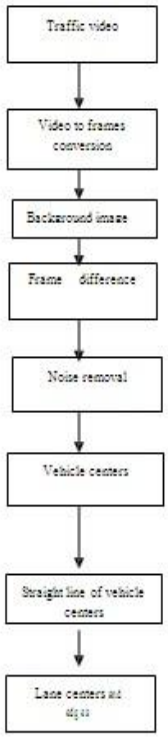



Fig1: Traffic flow detection system

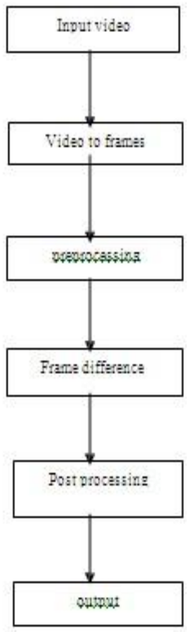



Fig2: Block diagram of frame difference

**A. SELECTION METHOD OF ROI**

Various selection methods of ROI have been proposed in the literature, which can be classified into one of the following three categories: 1) Frames subtraction method; 2) Background update method; 3) Virtual loop method. Comprehensive methods are also proposed based on the above methods. Cao proposed a new method combined image differences and background updating to extract the ROI information and acquired good result. The objective of select methods of ROI is to find possible vehicle location in an image quickly for further vehicle detection and tracking.

Frames Subtraction Method: Frames subtraction methods employ a threshold technique over the inter-frame difference, where pixel differences or block difference (in order to increase robustness) has considered. These techniques utilize the double difference on two or more successive frames to detect a ROI. The advantage of these methods is that it’s an adaptive method. The major problem of these techniques is that it depends too much on the time interval of selection the successive frames and the velocity of the vehicle. Here we review below some representative approaches including inter-frame difference method, statistical test method and spatial Markov random field methods.

Inter-frame Difference Method: As one of the main popular techniques, inter-frame difference method has been used frequently for selection of ROI in computer vision. Frames subtraction methods detect moving objects region from current input image by performing a difference on two or three consecutive inter-frames. Meanwhile, a threshold criterion is provided to decide the ROI. The difference map is usually binarized using a predefined threshold value to obtain the motion region. The advantage of these methods is easy to realize and its low computation. However, the advantage of these methods is low efficiency, especially where there is no prior knowledge. In order to overcome the shortcoming of these methods, adapted threshold techniques are proposed.

Statistical Test Method: These methods are constrained to pixel-wise independent decision, as a step forward of Inter- frame difference methods. The methods assume intrinsically that the detection of temporal changes is equivalent to the motion detection. The shortcoming of this method is that this assumption is valid when either large displacements appear or the object projections are sufficiently textured. To overcome this drawback, temporal change detection masks (Gabor spatial-temporal change detectors) and filters have also been introduced. The application of these masks improves the efficiency of the change detection algorithms, especially in the case where a prior knowledge about the size of the moving objects is Available.

Spatial Markov Random Field method: In order to avoid the limitation of prior knowledge about the size of the car, spatial Markov random field method is provided. Motion detection is considered as a statistical estimation Problem in this method. Background Update Method Background update techniques are mostly used for detection of motion in many real-time vehicle detection and tracking applications., including frame average method, selective updating method, minimum and maximum intensity value method, mixture of Gaussian Method and k-means clustering techniques. In these approaches, difference between the future frame and the constructed background image is performed to detected foreground objects. Background subtraction provides most complete feature information, but the problem of these techniques is that it is extremely sensitive to dynamic scene changes due to lighting and extraneous events. Robust background models are proposed by many researchers in order to solve the problem, meanwhile improving the efficiency and accurate of acquiring ROI. 1) Frame Average Method: Frame average method is a classical while famous technique for vehicle detection. The main point of it is to establish background frame in order to separate the ROI from current image and then ROI can be detected. Background is established by calculating average value of several consecutive frames in these methods. The main drawback of this method is that it's difficult to detect stationary cars or the low velocity cars. The key point of these methods is that how to update the background adaptively.2) Selective Updating Method: Different from frame average method, only selective region of frames are updated for selective updating method. Wang proposed a method that models the background into dynamic regions and a quasi-static region (i.e., road region). A block-based Eigen-space approach is used to model the quasi-static background. The advantage of these methods is that it improves the robustness. However, this technique needs prior knowledge to confirm the region to update. 3) Minimum and Maximum Intensity Value Method In these methods minimum and maximum intensity values, and maximum temporal derivative for each pixel are stored to initialize background model. The background model is periodically updated by using a combination of pixel-based Method and object-based method. Kalman and Brandt propose an adaptive background model using Kalman Filtering to adapt to the temporal variation of weather and environmental illumination. Stauffer and Grimson used a mixture of normal distributions to model a multi-model background image sequence. 4) Mixture of Gaussian Method The pixel-level mixture of Gaussians (MOG) background model has become very popular because of its efficiency in modelling-multi-modal distribution of background (such as waving trees, light reflection, etc.). It can adapt to a change of the background and implement the method in real time potentially. The basic idea is to assume that the time series of observations, at a given pixel, is independent of the observations at other image pixels. Friedman and Russell modeled the intensity values of apixel by using a mixture of three Normal Distributions and applied the proposed method to traffic surveillances. ) K- means Clustering Techniques Cluster analysis can be performed on the coefficient space to build a self-consistent aggregation of many individual. By taking into account changing pixels of vehicle region, vehicle geometry can be estimate from stable video sequences. This method doesn't need a prior calibration of the image sequences. Virtual Loop Methods: Virtual Loop methods exploit the concept of inductive loop to detect vehicle passing by monitoring illumination change in pre-specified region of a frame during vehicle detection processing. Virtual Loop Methods employ prior knowledge to select the ROI directly. The Selection of ROI is based on the decision of human based on the need of Detection requirement. In general, lanes are always selected as ROI. As the kind of processing checks the pre-specified Regions of frame only, its processing speed is fast. However, it's hard to setup and its function is limited. This region of interest is used in vehicle detection techniques. Now we will see the vehicle detection methods.

**B. Vehicle Detection Techniques**

The input to the vehicle detection step is the set of ROI from the selection of ROI step. Vehicle detection methods can be classified into the following three categories: 1) knowledge- based methods; 2) motion-based methods and wavelet-based methods. Knowledge-based methods employ a prior knowledge detect the position of vehicle in ROI. Motion- based techniques detect vehicles using optical flow. Wavelet-based approaches detect vehicles wavelet neural network or wavelet based function. A. Knowledge-based Methods Knowledge-based methods employ a prior knowledge to decide whether the ROI is vehicle or not in an image. We review below some representative approaches using information about symmetry,
color, shadow vertical/horizontal edge, texture, 3D model and wheels. 1) Symmetry As one of the main signatures of man-made objects, symmetry has been used often for object detection and recognition in computer vision. The observation of vehicles from the stationary camera are general symmetrical in the horizontal and vertical directions. That can be used as a cue for vehicle detection in several studies. However, symmetry is sensitive to noise. 2) Color although few existing systems use color information to its full extent for vehicle

detection, it is a very useful cue for vehicle detection, lane road following etc. Several prototype systems have investigated the use of color information as a cue to follow lanes, or segment vehicles from background. Techniques based on motion and color segmentation have been introduced to detect moving objects by taking advantage of color images Vehicle segmentation is obtained by frame differentiation while color segmentation consists of a split-and-merge algorithm.Y. Liu proposed an approach combining adaptive background representation

with hue- saturation- value (HSV) color spacing mapping to automatically adapt the feature segmentation algorithm to detect moving object in outdoor scenes with high robustness to weather and lighting variations. 4) Vertical/Horizontal Edges Using constellation of vertical and horizontal edges has shown to be a strong cue for vehicle detection. There are two types of edges based detection methods: conventional gradient based edge detector and morphological edge detectors. The conventional gradient-based edge detection operations have found wide acceptance in image processing applications, such as Sobel operator and generalized Hough transform (GHT). However, morphological edge detectors have shown better performance than conventional edge detectors while having a lower computation cost.Morphological edge detection uses a combination of mathematical morphological operation like dilation and erosion to detect edges.

The morphological edge detection highlights sharp grey- level transitions in the input image. 5) Texture The presence of vehicle in an image causes local intensity changes. Due to general similarities among all vehicles, the intensity changes follow a certain texture pattern. This texture information can be used as a cue to locate the possible vehicle in ROI for vehicle detection. Entropy was first used as a measure for texture detection. Only regions with high entropy were considered for future processing.

Motion-based Methods: All the cues discussed so far use spatial features to distinguish between vehicles and background. Another cue can be employed is motion of vehicles via the calculation of optical flow. Pixels on the images appear to be moving due to the relative motion between the sensor and the scene. The vector field of this motion is referredas opticalflow. Motion-based vehicle detection methods use characteristics of flow vectors of moving objects over time to detect moving regions in an image sequence. Optical flow based method can be used to detect independently moving vehicles from camera. However most flow computations are computationally complex and very sensitive to noise for it's not very easy to derive a reliable dense optical flow estimate under a stationary camera. It's hard to be applied to analysis the video streams in real-time without specialized hardware.

Wavelet-based Methods: Wavelet transform has recently been recognized useful tools for various applications such as signal image processing. For vehicle detection based on wavelet analysis, the motion is characterized via the entire

3-Dspatio-temporal data volume spanned by the moving vehicle in the image sequence. These methods generally consider motion as a whole characterize its spatio-temporal distributions. Wavelet-based methods by taking advantage of spatio-temporal motion characterization are able to acquire better performance both in spatial and temporal information of vehicle motion. Their advantage is low computational complexity and a simple implementation.

However, these methods are susceptible to noise and to variations of timings of movements.

**C. Shadow Eliminate Methods**

In video-based surveillance systems, extract of ROI is the first step in video processing. Then various techniques are used to detect whether a vehicle exists in ROI. In order to acquire accurate results, various shadow-removed methods have been proposed for the suppression of moving Cast shadow.

1) Cast shadow pixels fall on the same surface as the background.
2) Cast shadow pixels are darker than their background in all three channels R, G, B.
3) Background is mostly road surface which is often monochrome in traffic scene. As a result, the values of hue channel are little in the cast shadow regions.
4) The edge pixels of the cast shadows are significantly less than that of the vehicle.

Without ROI we can detect the vehicles through the frame difference also. In the background subtraction we cannot detect the vehicles in lightning conditions, so to overcome these problems we go to frame difference and edge detection methods.

Frame difference and edge detection methods are used for vehicle detection and lane detection even in illumination conditions. Lane detection is main aim in this proposed system. In previous work for detecting the lanes they used vehicle histogram ,but here directly we find the vehicle center in different frames. By those centers, lanes edges are founded. Mainly the above proposed algorithm will give the vehicle centers and lane edges using background information.

## III .TRAFFIC FLOW DETECTION

### A. Detection of background information

We will take the background frame ie.. without any vehicles only the background image was taken. After taking the background image we will convert them into binarization values. We assume (x, y) to be the edge information of frame i . Before adding several frames together, we cut the peak value for each frame in advance and the result is defined as gi (x,y)

gi (x,y) ={g if ( (x, y) >g)

{ (x, y if ( (x, y) g) - (1)

Her g is decided by the number of frame n under the condition $g\times n \leq 255$ . Then the frames are added to get b(x, y) and the binarization of b(x, y) is calculated to get the background edge.

$$b(x, y) = \sum_{i=1}^{n} g_i(x, y)$$

$$b(x, y) = \begin{cases} 1 \text{ if } (b(x,y) > b) \\ 0 \text{ if } (b(x,y) \leq b) \end{cases} \quad - \quad (2)$$

There are still some differences between the background we get and the real background. If we subtract the background from the frame to get ROI, there must be some background information left in foreground. So here we adopt a method to compare the background and the frame. If a pixel in the frame is the edge of background, the pixel is eliminated from the frame. Or it will be taken as the motion part. This method helps to keep the integrity of the vehicle. Here threshold value limitation is there. By fixing the 0's and 1's white and black pixels will be in that form.

Fig3: original video


Fig 4: Background image

**Difference image**

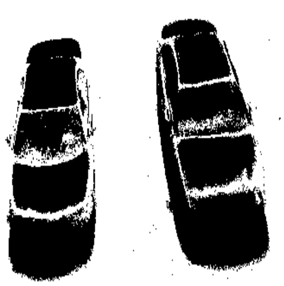


Fig5: Frame difference

The above figure shows background image and frame difference. these vehicles will be in different positions in different frames.

In the frame difference background will be subtracted and the foreground objects will be highlighted by the pixel values and thresholding.

In general, if a vehicle moves regularly, its center will be very close to one of the lane centers. When more vehicles are collected, their trajectories will be gradually close to the central lines of lanes. The video will be converted into frames. Here we will get 23 frames, and we will do the frame difference. The last frame will be without vehicles. By taking the last frame we can detect the lanes but there will be some noise, for noise removal we use the frame difference and threshold pixel in foreground objects. The frame difference will be applied and this differencing algorithm is spitting out vary too much to provide smooth movement of the image.

For simplifying the problems of vehicle segmentation, this paper assumes all the analyzed frames are captured by a still camera. When the camera is static, different moving objects can be detected through background subtraction. Assume that Ik and Bk are intensities of the kth frame and background, respectively. The difference image Dk(x, y) used to detect moving objects can be defined as follows:

Dk(x, y) = 0, if |Ik(x, y) − Bk(x, y)| ≤ Td

1, otherwise

Where Td is a predefined threshold and chosen as the average of the difference image Dk(x,y). After subtraction, a

series of simple morphological operations is applied for noise removing. The frame difference is used to detect the objects efficiently in motion. After frame differencing, we will get the noise on the lane road. so we will remove the noise. Mainly We have to find the vehicle centers in the lanes in different positions. after removal of noise, we will do

binarization. Now we will see the lane detection algorithm as shown in below steps

**Step 1:** Initialize all entries of $H_{vehicle}$ to be zero.

**Step 2:** For all vehicles $v_k$ , calculate $H_{vehicle}(x_{v_k}, y_{v_k}) += 1$

**Step3:** find the $H_{vehicle}$ using the equation

$$\overline{H}_{vehicle}(i, j) = {}^{1}\!/_{5} \sum_{k=-2}^{2} H_{vehicle}(i+k, j) \tag{5.4}$$

**Step 4:** Get the average value of $\overline{H}_{vehicle}$ at the jth row, i.e.

$$T_H^j = \frac{1}{N_{col}} \sum_i \overline{H}_{vehicle}(i, j)$$

**Step 5:** for each pixel (i, j) along the jth row, if $H_{vehicle}$ is a local maximum and larger than $T_H^j$ Set $H_{vehicle}(i, j)$ to 1; otherwise, set $H_{vehicle}(i, j)$ to 0.

**Step6:** Apply a connected component analysis to $H_{vehicle}$ for finding all its isolated segments. Eliminate each segment if its length is short, i.e., less than 0.5 $T_L$ where $T_L$ is the average length of all segments.

**Step7:** Merge any two adjacent segments if they are Very close to each other. Set all the remained segments as the lane centres.

**Step8:** Let $C_{Lk}^j$ be the centre of kth and jth row. Then, each lane dividing line (except the most left and right ones) can be determined as follows:

$$DL_k^j = 1/2(c_{Lk-1}^j + c_{Lk}^{j)}$$

Where $DL_k^j$ is the point at the jth row of the kth dividing line. In addition, the lane width of the lane width $W_{Lk}^j$ of the kth lane at the jth row is obtained as:

$$W_{Lk}^j = \left| C_{Lk}^j - C_{Lk-1}^j \right|$$

**Step9:** For the most left and right dividing lines, i.e., $D_{L0}$ and, their positions at the jth row can be extended from $DL_1^j$ and $DL_{NL-1}^j$

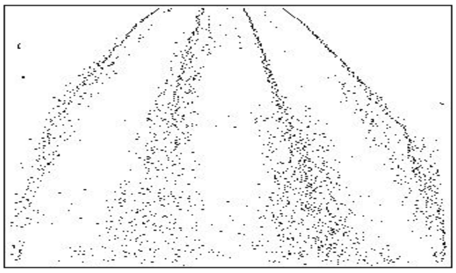


Fig 7:detection of lanes with noise while frame differencing

The above figure shows the lanes detection without noise removal. To remove the noise we will use the morphological operations. After noise removal we will detect the vehicle centers by the maximum values and minimum values of vehicle distance like x axis and y-axis. based on the vehicle center We will calculate lanes distances.

Fig8. vehicle centers in different frames

## IV.VEHICLE COUNTING METHOD

**Flow Chart for Vehicle Counting**

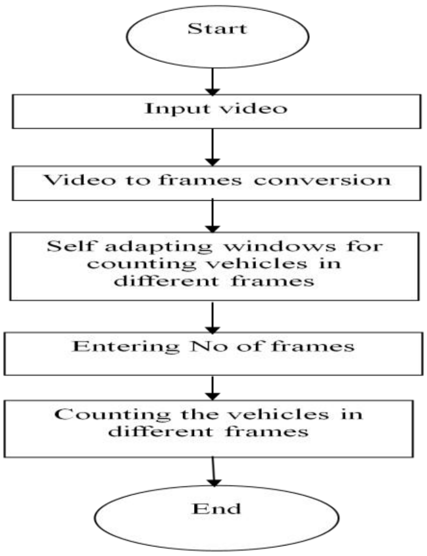
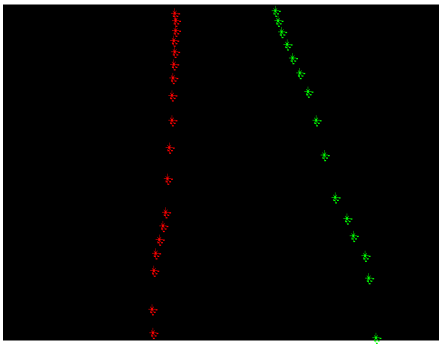



Fig 9. flow chart for vehicle counting

## V .EXPERIMENTAL RESULTS

The above algorithm is implemented using mat lab and the Traffic video is taken from smart cameras. For the first set of experiments, the performance of our proposed detection algorithm of lane-dividing lines was examined. Fig 6 shows

the detection results of dividing lines extracted from the first three vehicle sequences. Clearly, All the desired dividing lines were correctly extracted. When traffic is heavy, different lane changes will happen and will disturb the work of vehicle voting. Mainly the detection of lane dividing lane canters is the main role in traffic flow detection. In real conditions, although the traffic jam will include many lane changes, it also brings more regular vehicles moving on the same lane for the vehicle voting. It is noticed that regular vehicle movements always happen more frequently than irregular ones. The existence of lane change can be considered as a kind of noise. Since our method is statistics based, the unexpected effect of lane change can be easily removed using a smoothing technique (see step 3) in this algorithm). The accuracy of our algorithm can be easily verified by comparing the differences between the true lane- dividing lines and the estimated ones.



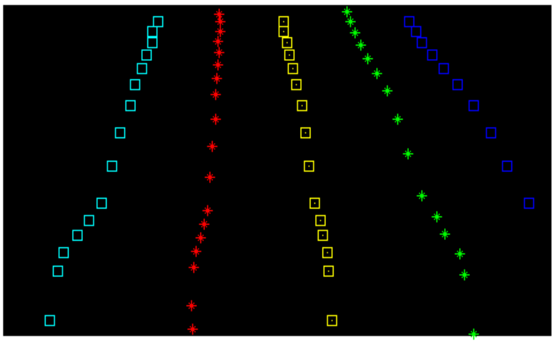


Fig 10. Straight Line of Vehicle Center

Fig 11. Combination of Vehicle Centers and Lane Edges

Table.1 Rate of accuracy of proposed method

| Type of road | Rate of accuracy | total no of vehicles in the video | no of vehicles correctly estimated |
|---|---|---|---|
| Single lane road | 90% | 10 | 9 |
| Double lane road | 70% | 10 | 7 |

## References


[1] Michalopoulos, P.G., Vehicle detection video through image processing: the Auto scope system. Vehicular Technology, IEEE Transactions on, 1991. 40(1): p. 21-29.

[2] Jun-Wei, H., et al., Automatic traffic surveillance system for vehicle tracking and classification. Intelligent Transportation Systems, IEEE Transactions on, 2006. 7(2): p. 175-187.

[3] Zhang, J. and Z. Liu. A vision-based road surveillance system using improved background subtraction and region growing approach. 2007. Qingdao, China: Inst. of Elec. and Elec. Eng. Computer Society.

[4] Chen, B., Y. Lei, and W. Li. A novel background model for real-time vehicle detection. 2004. Beijing, China: Institute of Electrical and Electronics Engineers Inc.

[5] Stauffer, C. and W.E.L. Grimson, Adaptive background mixture models for real-time tracking. Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition,1999.2:p. 246-252.

[6] M. Fathy and M.Y. Siyal, Senior Member, A Window- Based Image Processing Technique for Quantitative and Qualitative Analysis of Road Traffic Parameters IEEE Transactions on 1998.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