*Available online www.jocpr.com*

**Journal of Chemical and Pharmaceutical Research, 2014, 6(7):1941-1947**

**Research Article**

**ISSN : 0975-7384**
**CODEN(USA) : JCPRC5**

# Mobile video monitor of vehicles in online sensing

**Guofeng Qin, Sichang Li*, Qiyan Li and Lisheng Wang**

*The Computer Science & Technology Department, Tongji University, Shanghai, China*

---

**ABSTRACT**

*Detection of vehicles plays an important role in the area of the modern intelligent traffic management. With the pattern recognition in the area of computer vision, an auto-recognition system in an online sensing platform is studied. In the online sensing platform, 3G wireless network, including GPS, GPRS (CDMA), Internet (Intranet), remote video monitor, and CANBUS networks are integrated. The remote video stream can be taken from the terminals and sent to the online sensing platform, then detected by the auto-recognition system. The images are pretreated and segmented, including feature extraction, template matching and pattern recognition. The system identifies these models and gets vehicular traffic statistics.*

**Key words:** Online sensing; Mobile monitor; Feature extraction; Image recognition

---

## INTRODUCTION

In ITS, recognition and flow statistics of vehicles are very important technologies. Recognition technologies include image recognition technology and radio frequency technology. The first one is utilized in recognition of vehicle branch picture; the second one is to use radio frequency sensor to get to status of vehicles. In generally, images must be coded, compacted, enhanced, and corrected in pretreatment; then edge detection method is used to position and divide the Images, and start pattern recognition. Because of noise pollution and lighting effects to the original images, recognition precise is still to be improved. Radio frequency technology is precise, but the sensor cost is very expensive.

In the paper, a remote video monitor system of vehicles in online sensing platform is studied. The objective and motivation are to acquire the video information from the video monitors with the third generate wireless network; the video information will be collected and dealt with in a online sensing platform by a wireless video sensor network, including management and monitoring. The remote video stream is got from the video monitors, and sent to the traffic control center; the video information will be dealt with and classified, then the vehicles will be recognized from the images, and flow of vehicles through every road will be accounted. In recognition of vehicle flow, there are video stream information acquire, vehicle flow detection, vehicle flow track, and vehicle check. Video information is collected from the remote video monitors, and divided to pictures in frame format. The pictures will be dealt with edge feature detection, and recognition. Vehicle flow detection is to judge if there is vehicle flow, and separate vehicles in dynamic and complex background. Vehicle flow is counted dynamically, and vehicle type is classified according to samples in vehicle model database. The data and information are auto-saved in OLAP database for management and strategic.

## SYSTEM FRAMEWORK OF VIDEO MONITOR ONLINE SENSING PLATFORM

The video monitor online sensing platform consists of the intelligent mobile terminals, software systems, integrated 3G, including GPS, GPRS (CDMA), Internet (Intranet), remote video monitor and CANBUS networks. In our integration platform, the vehicles' GPS information, driver request messages, and the control center command information are sent by the integrated WAN on 3G and Internet(Intranet).

The mobile terminals are the interface directly with the users. We have implemented a rich set of functions for them. They have the capability of sending and receiving information in real time. It integrates the mobile computing, picture recognition, intelligent control, communication, wireless sensor and media streaming. The video monitor is integrated to the terminal by CAN or USB interface.

A multiple layer structure for our online sensing platform is designed. The platform is divided into a couple levels: the application layer, network layer, logical layer and data layer. The application layer includes the mobile terminals, B/S(Browser/Server structure) clients, C/S (Client/Server structure) clients. B/S client software supports dynamic dispatch, alarm monitor, service, map browsing, query, table and data backup. C/S client software supports map browsing, database management, table print, and so on. The network layer comprises wireless communication network, Internet, Intranet, and wireless sensor network. The mobile terminals are linked to the wide area communication networks. The B/S clients are connected through Internet and Intranet while the C/S clients are connected to the Intranet. The logical layer includes the platform group wares and middle wares. The platform software includes the software for communication, application, GIS, Web Server and the interface. The middleware are composed of XML data protocol transfer ware, JDBC, NIO(Non-blocking Input/Output), RMI(Remote Method Invocation), Load balancer, and so on. The data layer includes all the databases. The detail can be seen in Fig.1.

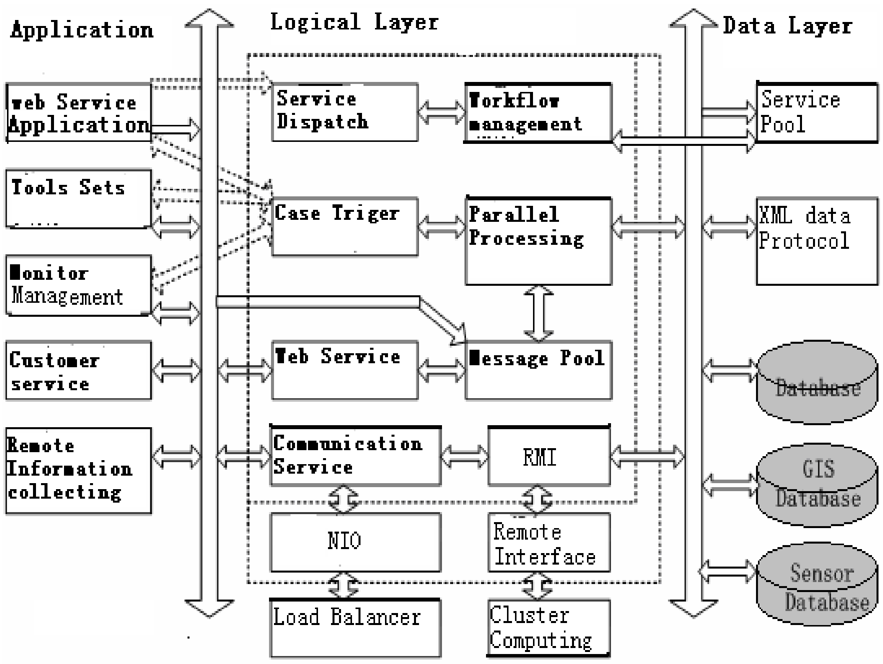


**Fig. 1: Framework of video monitor online sensing platform**

In the online sensing platform, there are video stream acquire, frame image collect, image pretreatment, image enhance, image partition, image feature extract, sample database, image recognition, study network, network compute, account and statistics. DirectShow software is used to acquire video stream and divide the frame images. In order to improve the quality of the images, the noise must be filtered to decrease interferences. The images must be enhanced and transferred in pretreatment procedure in order to get the better clearance.

In image partition, objects and un-objects must be separated from background; the regions of the different objects must be divided according to their characters. In the divided regions, the basic characters must be extracted and described, including gray, texture, and geometric characters.

## IMAGE RECOGNITION METHOD

Image pretreatment and image partition are very important procedures in image recognition. Image search algorithm transfer the color image to gray image, and enhance the image, then extract the edge characters. The image enhance is used to prominent some helpful information, Inhibit some helpless information, and expand the differences among the different objects. In order to acquire and recognition the object characters, the object must be divided from the background.

## IMAGE PRETREATMENT

Images must be transferred from color images to gray images, and enhanced, according to the color transformed gray formula p=0.299*R+0.587*G+0.114*B, p is gray value of one pixel, R, G and B are respectively read, green and blue values in RGB color model [6]. Filtering is very important to restrain the noise. Generally, filtering algorithms includes average value filtering, Wiener filtering and middle value filtering algorithms [9]. In the paper, middle value filtering algorithm with the Laplace operator is utilized because it can restrain the noises and keep the clearance for the images [7][8]. It is an un-linear signal treatment method, and can give up the indistinct feature, remove the noises and protect the edge character in the images. In order to smooth the images, the second order differentiation is used to filter the noises.

After smoothing treatment for images, they must be enhanced so that the region of vehicles in the images can be sticking out from the background. The gray histogram linear tensile method is used to permanent the region of vehicles. Many parameters are adjusted to permanent a gray area in the images. The gray transform equation is as follow.

$$D=AX+B \qquad (1)$$

In Eq.1, D is a transformed gray value, X is an original gray value, A and B are factors for the transform linear equation. In order to enhance the vehicle area and darken the background gray, the difference between the vehicle and background is improved, and the noises are constrained.

$$f(x,y)=\begin{cases} \dfrac{y_1}{x_1} & x\rangle x_1 \\ \dfrac{y_2-y_1}{x_2-x_1}\left(x-x_1\right)+y_1 & x_1 \le x \le x_2 \\ \dfrac{255-y_2}{255-x_2}\left(x-x_2\right)+y & x\rangle x_2 \end{cases} \qquad (2)$$

In Eq.2, the two points (x1,y1) and (x2,y2) are coordinates in branch--paragraph gray linear tensile equation [10] as Fig.2(a). (x1,y1) and (x2,y2) are two pair statistics set points in (255,255), the gray value of every pixel is in (0,255). X axis is coordinate axis of the original gray value, y axis is the transformed gray value coordinate axis.

From Fig.2 (b), (c) and (d), the vehicle area is enhanced and sticking out form the background, the noises are constrained.

**IMAGE SEGMENTATION**

Image segmentation is utilized in many vehicle type auto-recognition systems. In order to extracting the features and recognition the type of vehicles, a canny edge detection algorithm for image segmentation is used to separate the edge area of the vehicle from the background image, which can eliminate the untruth edge, remove the vibration of the images and smooth contour of the objects with corrosion and expansion method in mathematical morphology.

The edges of the images are basic features, which are very helpful information about the objects. There are many algorithms on image edge detection, including Sobel, Prewitt, Robert, Laplace, Log, and Canny algorithms [10]. Sobel and Prewitt algorithms are used to difference and filter the images, their weight-right value is different, and the detected edges are thick. Robert algorithm directly computes the difference, doesn't smooth the images, is sensitive to the background noises. Laplace algorithm uses the second order differential algorithm, and enhances the noises. Log algorithm uses Gauss function to smooth images, and uses the un-direction Laplace algorithm to extract the edges; but this method is easy to detect un-true edges in approximate gray area, is also sensitive to noises and not precise.

In the paper, Canny algorithm is utilized to detect the object edges with its anti-disruption and high precise. The first step is to notify all prominent edges which are detected by the minimum scale operator; the second step is to forecast and compose the prominent edges to some continue large edges with the large scale operator; the last is to compare the composed edges and the true edges, if similarity is very high, the composed edges will be notified. These large edges are accumulated to the edge graph.

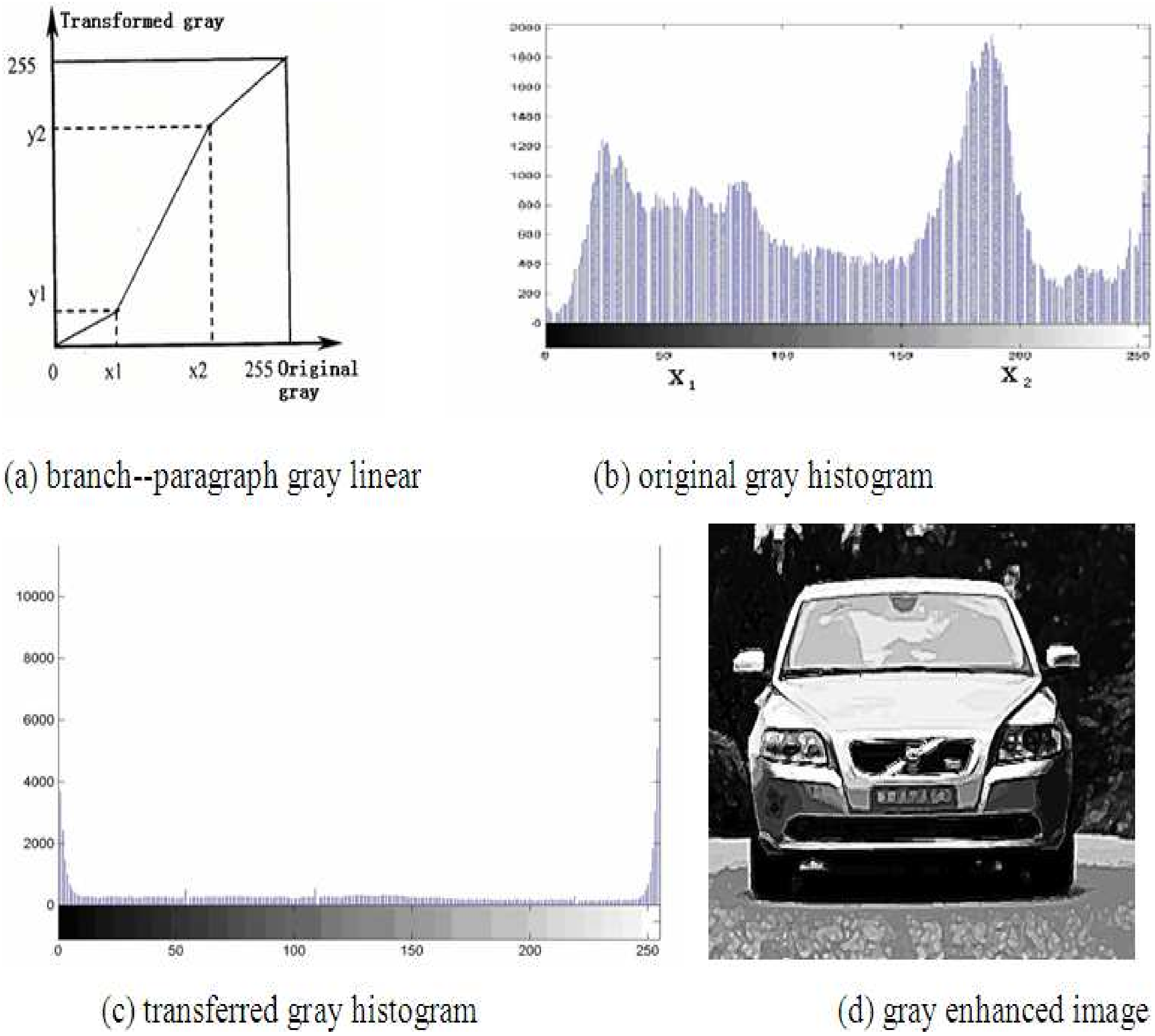


**Fig. 2: Gray tensile**

The Canny algorithm is applied many image recognition system because of its adaptability. In the binarize process, the Canny operator detects the original images and get the edge images, and adaptively adjusts the threshold. The non-isolated low gray pixel near the edges becomes the seed point, and fills the seeds in high threshold binary images; the edges will become the fences for the seeds. If gray value of the filled image pixel is below to the low threshold, the pixel color will be set to black, and many small connective regions will be delete as noises. The procedures of binary images include deleting un-true edges, sealing the near true edges, and choosing the seed point in objective regions. The binary image algorithm can be described as follow.

Algorithm:
(1) use Canny operator to detect the original image I, and get the edge images eI;
(2) delete the isolate small edges in eI. judge every point in eI, if it is an edge point, then push its four neighbor un-edge points into a temporary matrix T; if the number of points in T is large than 1, then push the low gray points in I into the matrix lE, and push the remain points into the matrix hE.

(3) get the low and high thresholds as Eq.3 and Eq.4.

$$LT = \frac{1}{m} \sum_{(i,j) \in lE} I(i,j) \quad (3)$$

$$HT = \frac{1}{n} \sum_{(i,j) \in hE} I(i,j) \quad (4)$$

(4) push the points in the matrix lE into the matrix S as seeds.
(5) use the high threshold to get a binary image hbI, set the points in the matrix hE or eI as background points, and get the filled seed image.
(6) the seed point in S is used to fill the binary image hbI, and judge the weight of the filled edge seed; if the weight value is greater than a set threshold, then the filled point is a objective point; otherwise, it is a background point. The binary edge image sbI can be gotten.
(7) integrate the high and low thresholds to deal with the image lbI and get the edge scattered image hlI.
(8) connect the scattered edges to get the edge image rI.

The algorithm has many advantages, including utilizing the Canny smooth feature for the edges, decrease the gray Inconsistency for the objects, delete the un-true objects, and constrain the noises and balance the feature details with the high and low thresholds. Of course, new noises could be take place because of the un-looped edges.

**BP NEURAL NETWORK MATCHING ALGORITHM ON FUZZY SETS**

There are Four methods are used to classify the objects, including matching on image gray, matching on features, matching on model and matching on transformed domain. The matching method on image gray setups the similarity between two images with the image gray. A search way is used to find the maximum or minimum transformed model parameter value on their similarity.

This method has good precise and robustness because it does not extract the features but only uses the image gray. Because of its great computation and increasing matching errors in Information poor region, it can not be suit for recognition of the vehicles.

The matching method on features only matches and computes some features, for example range, histogram, frequency coefficient, points and lines, it keeps some invariant features as the edge point, the center of close region, line, surface and array for matching two images. Its advantage is to extract the significant features and compress the information content of image, the computation decreases, becomes faster and keeps good robustness. In one side, because only a few images gray is used, this method is sensitive to matching and recognizing of the features with low precise.

The matching method on model is wildly applied in computer vision. The matching computation is one point by one point in the whole matching region; it is also sensitive to the noises, which must be eliminated. In matching process, matching with rigid shape and deformable template can be utilized to improve the convergence of the concave edges and sensitivity of the noises. The matching method on transformed domain includes Fourier transformer, Gabor transformer and wave transformer; the matching method on frequency domain can bear the noises and keep the invariance of rotation and size. Its result is not related to illumination.

In recognition algorithm, BP neural network is utilized for its good convergence. Firstly, a construction of BP neural network must be adaptive to recognize the vehicle. In the sample database, ten sample feature matrixes and their target matrixes are setup from ten type vehicles. The feature matrixes are 22*1 dimension matrixes, and the target matrixes are 10*1 dimension matrixes. The number 22 is the vector number of the features, and the number 10 is the number of the types. The number of the neuron is 22 in input layer, the number of the neuron is 10 in output layer, and the number of the neuron is adaptive in middle-layer according to some experience. The experience formula is defined as follow.

$$n_1 = \sqrt{n + m} + a \quad (5)$$

In the Eq. 5, n is the number of the input layer neuron, m is the number of the output layer neuron, a is a natural number in the area [1, 10], n1 is the number of the middle layer neuron. In this system, n1 is about 15. The details of BP neural network can be seen as Fig.3.

In the second step, the neural network must be trained with the sample feature matrixes and their target matrixes. Value of the function Sigmoid is in the area (0, 1), the data in input and output must be normalized in the area (0, 1). Weight matrices of 22*15 and 15*10 are randomized in the area (-0.5, 0.5). In training, tolerance is set to 0.001 so that the difference between the sample feature matrixes and their target matrixes is the minimum. If the tolerance is less than 0.001, and the feedback number is 10, this training is successful and ended; otherwise, it must be restarted.
In the third step, the weight matrices are gotten. After the all samples are trained, and a satisfied result is gotten, the weight matrices will be setup, which is saved in a txt format file and reused. Lastly, the image targets are recognized. The weight matrices are use to recognized the input image targets, the result will output. According to the result, if there are some samples in the current image, then the types of the vehicle and noise will be judged and accounted;

otherwise, they do not exist in the current image.

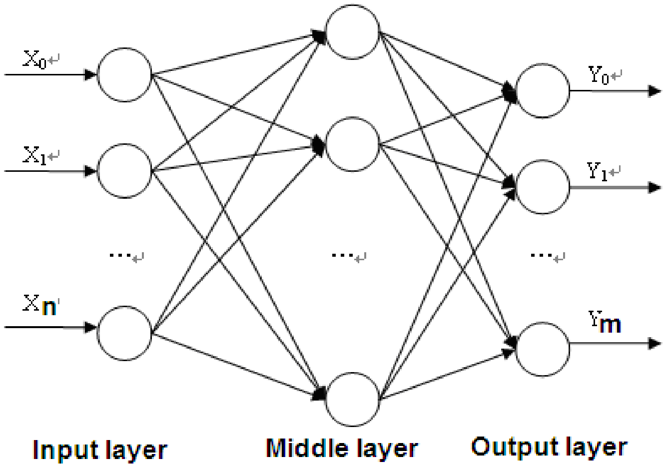


**Fig. 3: BP neural network**

BP neural network and fuzzy matching algorithm recognizes and induces the recognized case to vehicle or noise with two fuzzy sample sets, namely, noise feature fuzzy sets and vehicle feature fuzzy sets. If the case is a type of vehicle, it will be reserved and analyzed; otherwise, it will be noises, and be filtered. The details of the matching algorithm can be seen Fig.4.


**Fig. 4: Vehicle recognition in online sensing platform**

A video monitor online sensing platform is studied and developed. Many video monitors are integrated to a mobile vehicle terminal with CANBUS or USB interface. The video stream information with JPG image format is collected and sent to the video monitor online sensing platform. In the platform, the continue JPG frames are transferred to a video file, the recognition software deals with the video file, and classifies the types of the vehicle, and gets vehicular traffic statistics. In Fig.4, the white lines in mandarin are detected the contours of the vehicles with the improved canny operator. They are two contours of a small lorry and a small bus.

## CONCLUSION

In this article, a video monitor online sensing platform is studied and developed, including an Automobile Automatic Recognition System based on image. The online sensing platform take use of several video monitors linked to the mobile terminal to get traffic images, then after image pretreatment and segmentation, do the works of feature extraction, template matching and pattern recognition, to identify different models and get vehicular traffic statistics. In future, the algorithms will be improved to precise of vehicle recognition. This article contribution is focus on setup a wireless video sensor network to collect the video information to a cooperative platform; the information will be dealt with and saved just in time by high computing performance of the platform for management and service. In future, the middle wares in the online sensing platform will be developed and improved for management and service, including its Qos character of information responsibility and delivery.

**Acknowledgments**
The researcher is supported by the national 863 program in the Ministry of Science and Technology of China. Project no.2013AA040302.

## REFERENCES

[1] Guofeng Qin, Qiyan Li. Cluster Computing in Drug Logistic Monitoring and Mangement, Proceedings of the Fifth International Conference of Cooperative Design, Visualization, and Engineering, CDVE2008, v5220 LNCS, (**2008**)September 21-23; Mallorca, Spain.
[2] Guofeng Qin, Qiyan Li. An Information Integration Platform for Mobile Computing, Proceedings of the Third International Conference of Cooperative Design, Visualization, and Engineering, CDVE2006, v4101 LNCS, (**2006**) September 21-23; Mallorca, Spain.
[3] Guofeng Qin, Qiyan Li. Strategies for resource sharing and remote utilization in communication servers, Proceedings of the Fourth International Conference of Cooperative Design, Visualization, and Engineering, CDVE2007, v4101 LNCS, (**2007**) September 21-23; Shanghai, China.
[4] Guofeng Qin, Qiyan Li. Dynamic Resource Dispatch Strategy for WebGIS Cluster Services, , Proceedings of the Fourth International Conference of Cooperative Design, Visualization, and Engineering, CDVE2007, v4101 LNCS, (**2007**) September 21-23; Shanghai, China.
[5] Evelyn Brannock, Michael Weeks. Edge detection using wavelets, Database systems and computer vision.**2006**,p649-p654.
[6] M. Shari, M. Fathy, and M. T. Mahmoudi. A classied and comparative study of edge-detection algorithms, In Proceedings of the International Conference on Information Technology: Coding and Computing (ITCC.02), p 117-p120.
[7] Canny J. A Computational Approach to Edge Detection, *IEEE Trans* on PAMI,**1986**,8(6):679-698.
[8] Foedisch, M., and Takeuchi, A., Adaptive road detection through continuous environment learning, in Applied Imagery Pattern Recognition Workshop, 2004. Proceedings.33rd, Vol.,Iss.,13-15 Oct. **2004**.
[9] Jansen M,Malfait M,Bultheel A. Generalized cross validation for wavelet thresholding, Signal Processing,**1997**,56(1):33-44.
[10] Zou qi-jun,Li zhong-ke. Image Edge Detection Algorithm Contrastive Analysis, Computer Application, **2008**,6(28):215-216.
[11] H. Poor, An Introduction to Signal Detection and Estimation. New York: Springer-Verlag, **1985**, ch. 4.
[12] S. Chen, B. Mulgrew, and P. M. Grant, A clustering technique for digital communications channel equalization using radial basis function networks, IEEE Trans. Neural Networks, vol. 4, pp. 570–578, July **1993**.
[13] (Handbook style) Transmission Systems for Communications, 3rd ed., Western Electric Co., Winston-Salem, NC, **1985**, pp. 44–60.
[14] Arora A..*Traffic Engineering and Control*, v 53, n 10, p 375-378, November **2012**.
[15] B. Chen and H. H. Cheng. *IEEE Trans. Intelligent Transportation Systems*, vol.11, no.2, pp.485–497, **2010**.
[16] Seng Dewen. *Applied Mechanics and Materials*, v. 189, p. 482-485, **2012**.
[17] SENG Dewen, LI Zhongxue. *Journal of Liaoning Technical University*, Vol.27(1), pp.9-12, **2008**.02.
[18] Dikaiakos M. D..Minersoft: *ACM Transactions on Internet Technology*, v.12, n.1, June **2012**.
[19] Seng Dewen, ShuYueqing. *Advances in Intelligent Systems and Computing*, p. 393-400, **2013**.
[20] Di Lecce, V. Amato, A. *IET Intelligent Transport Systems*, v 5, n 3, p 149-158, September **2011**.