

Traffic Load Computation for Real Time Traffic Signal Control

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Abstract- Traffic load computation for real time traffic signal control system has become a challenging problem as well as the need of hour to make road traffic decent, safe, less time and fuel consuming. CCTV Cameras can prove to be a robust and sufficient solution in this direction. Images of the traffic captured with the help of CCTV Camera, can be processed to retrieve the required output about current traffic. This document presents a model to count the traffic load by some parameters such as edge detection, histogram equalization, labeling and removing the noise with the help of median filter. The load computed can then be used to control the traffic signals.

Keywords: Image processing, MATLAB simulation, Traffic load computation.

I. INTRODUCTION

The main purpose of the developed algorithm is to compute total traffic load at a particular junction, which is then further used for real time traffic control by generating green light timing of the traffic signal.

For computing traffic load, two data source images have to be input, one is blank road image and the other is its corresponding road image with vehicles. The two images are compared to count the number of vehicles present in the traffic load image. The load computed will then be used to control the traffic signals.

Image processing of load computation algorithm is done in Matlab environment. Various image processing operations like image segmentation and noise removal are performed on the input image to obtain the correct results. This paper comprises of six sections including the present one which describes the goal of this system. Section II presents the related work in real time traffic load. Section III gives a brief introduction regarding MATLAB environment and image processing. Section IV presents the experimental results which contain all procedures and figures. At last section V draws the conclusion.

II. RELATED WORK

Margrit Betke et al. [14] implemented a hard real-time vision system that recognizes and tracks lanes, road boundaries, and multiple vehicles in videos taken from a car driving on highways.

Yonggang Liu et al. [1] explained the traffic flow at the intersection of Archer RD. and SW 34th. during the weekday busy hours. The system features have been illustrated by using these data and the traffic flow has been modeled.

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Tran Duc Duan et al. [5] discussed a method which optimizes speed and accuracy in processing images taken from various positions. The problem of VLP recognition is a very interesting but difficult one. It is very useful for many traffic management systems. VLP recognition requires some complex tasks, such as VLP detection, segmentation and recognition.

Iryna Gordon et al. [10] described a sparse metric model of the real-world environment, provided interactive means for specifying the pose of a virtual object, and applied model-based camera tracking of image with visually pleasing augmentation results.

Alexandra Koutsia et al. [8] described traffic control and monitoring using video sensors that has recently drawn increasing attention, due to the significant advances in the field of computer vision. The paper presents a real-time vision system for automatic traffic monitoring based on a network of autonomous tracking units that capture and process images from one or more pre-calibrated cameras.

M.Y. Siyal et al. [7] discussed the processing of vehicle detection, vehicle count and queue parameters. A common and simple vehicle detection technique is the background differencing technique. This technique is based on a pixel-by-pixel comparison of a background image of a traffic scene (without any moving vehicles) and the current frame of the scene.

V.ELAMARAN et al. [2] discussed a real time image processing algorithm which is implemented on FPGA. Point processes are the simplest and basic image processing operations. They operate on a pixel bases only on that pixel's value. Point processing operations such as arithmetic operations, XOR operations, Histogram with Equalization, Contrast stretching and intensity transformations.

Duy-Nguyen Ta et al. [9] explain an efficient algorithm for continuous image recognition and feature descriptor tracking in video which operates by reducing the search space of possible interest points inside of the scale space image pyramid.

M. Chandrasekhar et al. [3] discussed about digital image to extract true image is a desired goal in several applications, such transformation is known as image enhancement. Performing the task automatically without human intervention is particularly hard in image processing. The transform is capable to perform both a nonlinear and a shape preserving stretch of the image histogram. This image enhancement results are compared to histogram equalization.

Abhishek Acharya et al. [4] discussed an efficient FPGA based hardware design for enhancement of color and gray scale image in image and video processing. The approach is used is adaptive histogram equalization which works very effectively for image captured under extremely dark

environment as well as non-uniform lighting environment where bright regions are kept unaffected and dark object in bright background.

Alper Yilmaz et.al [11] discussed tracking methods on the basis of the object and motion representations used, provide detailed descriptions of representative methods in each category, and examine their pros and cons. Moreover, discuss the important issues related to tracking including the use of appropriate image features, selection of motion models, and detection of objects.

Abhijit Mahalanobis et al. [6] show advantage of multiple cameras in order to monitor activity over a large area. The system must be able to handle both stationary and moving objects. The system must be able to detect, track and handed over moving objects between cameras in real-time.

Richard E. Raymond P.E et al. [12] explained to identify and quantify the more significant, heavier vehicular loads to which the city's streets are subjected, and provide a means of visualizing and Understanding how the various loads affect the service life of the city's pavement infrastructure particularly the local access streets.

C.C. CAPRANI et al. [13] discussed about traffic loading is one of the most variable parameters in a bridge reliability assessment. Its accurate assessment potentially offers large savings due to reduced bridge rehabilitation or replacement costs. The authors conclude that contrary to the common assumption, the governing form of traffic may be congested traffic.

III. MATLAB ENVIRONMENT AND IMAGE PROCESSING

A. Matlab Environment:

Matlab stands for matrix laboratory. As the name itself indicates, we deal with matrices when we work with matlab.

Matlab is a high level language that provides a highly interactive and user friendly environment to solve different classes of problems, the most prominent among them being Image Processing.

This is the set of tools and facilities that help you use matlab functions and files. Many of these tools are graphical user interface. It includes the matlab desktop and Command Window, a command history, an editor and debugger, and browsers for viewing help it workspace, files, and the search paths.

This is a vast collection of computational algorithms ranging from elementary function like sum, sine, cosine and complex arithmetic, to more sophisticated functions like matrix inverse, Matrix Eigen values, Bessel functions, and fast Fourier transforms.

B. Matlab Language:

This is a high-level matrix/array language with control flow statements, functions, and data structures, input/output. And object-oriented programming feature. It allows both "programming in the small" to rapidly create quick and dirty throwaway programs and "programming in the large" to create large and complex application programs.

C. Graphic:

Matlab has extensive facilities for displaying vectors and matrices as graphs, as well as annotating and printing these graphs. It includes high-level functions for two-dimensional and three-dimensional data visualization, image processing, and animation and presentation graphics. It also includes low-level functions that allow you to fully customize the

appearance of graphics as well as to build complete graphical user interfaces on your matlab applications.

The MATLAB Application Program Interface (API):

This is a library that allows you to write C and FORTRAN programs that interact with MATLAB. It includes facilities for calling, routine from matlab (dynamic linking), and calling matlab as a computational engine. And for reading and writing MAT-files.

D. Matlab Desktop:

When you start, the *Matlab* desktop appears, containing tools (graphical user interfaces) for managing files, variables, and applications associated with *Matlab*. The following illustration shows the default desktops. You can customize the arrangement of tools and document to suit your needs.

E. Image Processing:

Image processing is referred to processing of a 2D picture by a computer. An image defined in the "real world" is considered to be a function of two real variables, for example, $a(x, y)$ with a as the amplitude (e.g. brightness) of the image at the real coordinate position (x, y) . Modern digital technology has made it possible to manipulate multi-dimensional signals with systems that range from simple digital circuits to advanced parallel computers.

The goal of this manipulation can be divided into three categories:

Image processing (image in - image out)

Image Analysis (image in - measurements out)

Image Understanding (image in - high-level description out)

An image may be considered to contain sub-images sometimes referred to as regions-of-interest, ROIs, or simply regions. This concept reflects the fact that images frequently contain collections of objects each of which can be the basis for a region. In a sophisticated image processing system it should be possible to apply specific image processing operations to selected regions. Thus one part of an image (region) might be processed to suppress motion blur while another part might be processed to improve color rendition.

The most requirements for image processing of images is that the images be available in digitized form, that is, arrays of finite length binary words. For digitization, the given Image is sampled on a discrete grid and each sample or pixel is quantized using a finite number of bits. The digitized image is processed by a computer. To display a digital image, it is first converted into analog signal, which is scanned onto a display.

Closely related to image processing are computer graphics and computer vision. In computer graphics, images are manually made from physical models of objects, environments, and lighting, instead of being acquired (via imaging devices such as cameras) from natural scenes, as in most animated movies. Computer vision, on the other hand, is often considered high-level image processing out of which a machine/computer/software intends to decipher the physical contents of an image or a sequence of images (e.g., videos or 3D full-body magnetic resonance scans). In modern sciences and technologies, images also gain much broader scopes due to the ever growing importance of scientific visualization (of often large-scale complex scientific/experimental data). Examples include microarray data in genetic research, or real-time multi-asset portfolio trading in finance. Before going to processing an image, it is converted into a digital form. Digitization includes sampling

of image and quantization of sampled values. After converting the image into bit information, processing is performed. This processing technique may be, Image enhancement, Image reconstruction, and Image compression.

F. Image Enhancement:

It refers to accentuation, or sharpening, of image features such as boundaries, or contrast to make a graphic display more useful for display & analysis. This process does not increase the inherent information content in data. It includes gray level & contrast manipulation, noise reduction, edge detection and sharpening, filtering, interpolation and magnification, pseudo coloring, and so on.

G. Image Restoration:

It is concerned with filtering the observed image to minimize the effect of degradations. Effectiveness of image restoration depends on the extent and accuracy of the knowledge of degradation process as well as on filter design. Image restoration differs from image enhancement in that the latter is concerned with more extraction or accentuation of image features.

H. Image Compression:

It is concerned with minimizing the no of bits required to represent an image. Application of compression are in broadcast TV, remote sensing via satellite, military communication via aircraft, radar, teleconferencing, facsimile transmission, for educational & business documents , medical images that arise in computer tomography, magnetic resonance imaging and digital radiology, motion , pictures ,satellite images, weather maps, geological surveys and so on.

IV. EXPERIMENTAL RESULT

The experimental results for background registration in MATLAB are shown below in fig a:

- Initially image acquisition is done with the help of CCTV camera.
- First image of the road is captured when there is no traffic on the road.
- Capturing particular intersection or junction of road.



Fig1. Image of blank road

The experimental results for foreground detection in MATLAB are shown below fig 2:

- Fig 2. shows image of the road captured when there is traffic on the road.
- After registering the static objects the background image is subtracted from the second image to obtain the foreground dynamic objects.

- Post processing is performed on the foreground dynamic objects.



Fig 2. Vehicles on road

The experimental results for detection of object less than 200 pixels in MATLAB are shown below in fig 3:

- The first step is segmentation to object regions of interest.
- Here regions which may contain unknown objects have to be detected.
- Then focuses on the extraction of suitable features and then extraction of objects.



Fig3. Removing of object other than vehicles

The experimental results for filling holes and find boundaries in MATLAB are shown below in fig 4:

- There always exist some noise regions both in the object and background region.
- The object boundaries are also not very smooth; hence a post processing technique is applied on the foreground image.
- The final output of the object tuning phase is a binary image of the objects.



Fig 4. Smooth image and sharp boundaries

The experimental results for labeling image in rgb form in MATLAB are shown below in fig 5:

- This image is scanned from top to bottom for detecting the presence of an object.
- One variable is maintained i.e., count that keeps track of the number of vehicles.
- This concept is applied for the entire image and the final count of objects is present in variable count.



Fig5. Labeling of image in rgb form

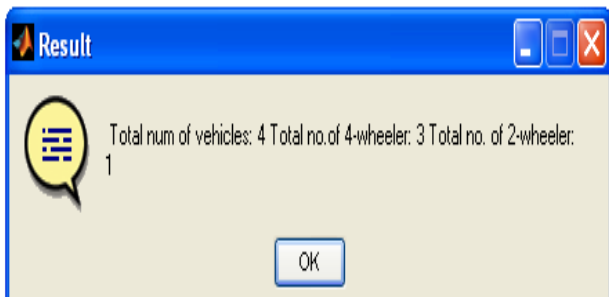
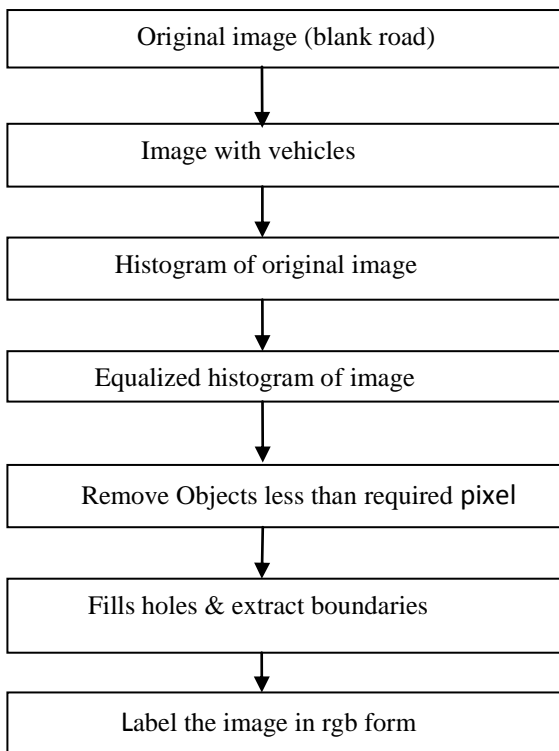


Fig6. Total number of vehicles

The complete procedure is shown by the following flow chart:

Flow Chart:



V. CONCLUSION

A novel approach is proposed to minimize the traffic load by computing the load with help of algorithm. Our system will be used in real time traffic control in metropolitan cities and places where traffic is a major concern. Primary functions of traffic load computation is to calculate number of vehicles at a particular instance with the help of real time algorithm It will take a CCTV image as an input source and display the count of vehicles.

REFERENCES

- [1] Yonggang. L, Kyungyong. L. "Modeling Signalized Intersection Using Queuing Theory", Available at "https://www.acis.ufl.edu/~klee/course_output/queueing.pdf"
- [2] Elamaran. V, Rajkumar. G. "FPGA Implementation Of Point Processes Using Xilinx System Generator", Journal of Theoretical and Applied Information Technology, 31st July 2012. Vol. 41 No.2
- [3] Chandrasekhar. M, Naresh. U, Reddy. S, Raju. N. "FPGA Implementation of High Speed Infrared Image Enhancement", International Journal of Electronic Engineering Research, ISSN 0975 - 6450 Volume 1 Number 3 (2009) pp. 279-285
- [4] Acharya. A, Mehra. R, Takher. V. "FPGA Based Non Uniform Illumination Correction in Image Processing Applications", International Journal of Computer Technology and Application, Vol 2 (2), 349-358
- [5] Mahalanobis. A, Cannon. J, Robert. S, Muise. R, "Network Video Image Processing for Security, Surveillance, and Situational Awareness", SPIE Proceedings Vol. 5440, 10 August 2004, DOI: 10.1117/12.548981
- [6] Siyal. M.Y, Fathi. M, Atiquzzaman. M. "A Parallel Pipeline Based Multiprocessor System for Real-Time Measurement of Road Traffic Parameters", Volume 6, Number 3, June 2000, pp. 241-249(9), Elsevier
- [7] Koutsia. A, Semertzidi. T, Dimitropoulos. K, Grammalidis. N. "Intelligent Traffic Monitoring And Surveillance With Multiple Cameras", Content-Based Multimedia Indexing, 2008. CBMI 2008, 18-20 June 2008
- [8] Bosman. J. "Traffic Loading Characteristics Of South African Heavy Vehicles", Proceedings 8th International Symposium on Heavy Vehicle Weights and Dimensions, 14th - 18th March, Johannesburg, South Africa, ISBN Number: 1-920-01730-5
- [9] Nguyen. D, Chao Chen.T, Gelfand. N, Pulli. K." Efficient Tracking and Continuous Object Recognition using Local Feature Descriptors" , In IEEE Conf. on Computer Vision and Pattern Recognition (CVPR09), Available at "http://people.csail.mit.edu/kapu/papers/nguyen_cvpr09.pdf"
- [10] Gordon. I, Lowe. D." Scene Modeling, Recognition and Tracking with Invariant Image Features", ISMAR, Arlington, VA, page 110-119, 2004
- [11] Yilmaz. A, Javed. A, Shah. M." Object Tracking: A Survey", CSUR Journal volume 38 issue 4, 2006 Article no 13
- [12] Richard E. Raymond P.E., " Pavement Performance Considerations for Heavy Traffic Loads", Available at "http://www.inlandrail.org/documents/FactPaperForHeavyAxleLoad s.pdf"
- [13] Caprani C C., Obrien E. J." The Governing Form Of Traffic For Highway Bridge Loading", Available at "http://www.colincaprani.com/files/papers/Conferences/BEI08%20-%20Caprani%20&%20OBrien.pdf"
- [14] Betake. M, Haritaoglu. E, Davis. L." Multiple Vehicle Detection and Tracking in Hard Real Time", Machine Vision and Applications (2000) 12: 69-83, Springer-Verlag 2000
- [15] Siyal. M. Y." A Novel Image Processing Approach for Qualitative Road Traffic Data Analysis" , International Conference. on Electronics, Control & Signal Processing and 2002 WSEAS Int. Conf.one-activities Singapore, December 9-12, 2002



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