Counting Cars in Traffic Using Cascade Haar with KLP

Chirag I. Patel and Ripal Patel

***Abstract*—Detection of vehicles in images represents an important step towards achieving automated roadway monitoring capabilities. The challenge lies in being able to reliably and quickly detect multiple small objects of interest against a cluttered background which usually consists of road signs, trees and buildings. To this end we present a Proof of Concept Traffic monitoring application. The application counts the number of cars passing in either direction. Car detection is done using a boosted cascade of Haar features and is combined with the pyramidal KLT tracker to achieve a fast monitoring system.**

***Index Terms*—Video processing, object detection, ada boost algorithm, machine vision.**

I. Introduction

Automated Traffic Data Collection and surveying can be a great tool in site selection, engineering, and more. A robust and real time implementation of the above is a challenge however, especially in cases of high occlusion and a cluttered background.

Luo-Wei Tsai *et al*. [1] present vehicle detection approach for detecting vehicles for static images based on color and edge. Based on color of vehicle important vehicle is extracted from background. Then three important features including corner, edge maps and coefficient of wavelet transform are calculated for detected vehicle and feed them into cascade multi-channel classifier for verifying all possible candidates quickly.

Hsu-Yung Cheng *et al*. [2] present automatic vehicle system classification design based on pixel wise relations among neighboring pixels in a region used for feature extraction process. Local feature and color feature are used for detection of vehicle. Moment preserving edge detection is applied for calculating local features of image and color transform used to separate vehicle color and non-vehicle color. A dynamic Bayesian Network is build up for classification purpose.

Alberto Broggi et al [3] has developed vehicle detection based on high vertical symmetry for areas. Using different size of boxes at column centre are considered to find symmetry. Detected object is considered with column which has high symmetry. For horizontal information of object horizontal edge is calculated. Proposed algorithm is detect all size of bounding boxes.

Zehang Sun et al [4] present approach for vehicle detection based on feature extraction and classifier process. Gabor filter is used to extract features of vehicle and support vector machine (SVM) is used for vehicle detection.

In this work, we have created car detection and counting system achieving a frame rate of almost 9 frames per second.

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Chirag I. Patel is with the Computer Science Department, Nirma Institute of Technology, Ahmedabad, India (e-mail: chirag453@gmail.com).

Ripal Patel is with the Electronics & Commu. Department Dharmsinh Desai institute of technology, Nadiad, India (e-mail:ripalpatel315@gmail.com).

II. The Ada Boost Algorithm for Classifier Learning

The Viola Jones [5] approach is based on a machine learning technique which is capable of achieving a very high rate of detection without being highly computationally intensive. We have used this technique to limit our region of interest,so that the region for further processing can be reduced significantly. The training process consists of a supervised process to train the attentiosnal operator to detect objects of a particular class. The parameters of the training phase are number of stages, number of splits in the decision tree, number of features and minimum size of features. For our problem, we trained the classifier for 15 stages with 3 splits, 17 kinds of Haar features and a size of 35x20. We trained on a set of 1920 positive samples of cars with 450 negative samples. We tried training the classifier for different sets of positive and negative samples. For example, partitioning cars into left facing and right facing sets did not improve detector performance. Also, training the detector with images of similar objects like buses and Autos in the negatives also reduced performance. The detection stage achieved a frame rate of 16-18 frames per seconds.

III. Tracking

We have used pyramidal KLT algorithm for tracking. We have combined detections by the Haar Cascade classifier with Pyramidal KLT to improve the count results. The heuristic algorithm used for combining the results is given in Fig 2. The feature points for an object are re-calculated after an object is matched with a detection so as to remove lost feature points. The HarrisCorner Detector is used for choosing salient points in a region of interest. An object is said to be matched with an object if a THRESHOLD percentage of its points are contained in the detection window. Moreover, in order to reduce false counts, an object which is not matched with detection in MAXFRAMES number of frames is ignored in the final count. When a RIGHTTHRESHOLD percentage of points associated with an object go out of the window the object is counted.

IV. Tuning

There are some parameters in the algorithm which can be

tuned to get desired results. The chosen values and its meaning is given below:

A. Threshold

How many feature pointsof an object (%) must becontained in a detection for it to be treated as same object.

B. Countthreshold

Number of feature points of an object (%) to have crossed theboundary for it to be considered as passed.

C. Left Window and Right Window

These define the left and right boundaries of thescene of observation.

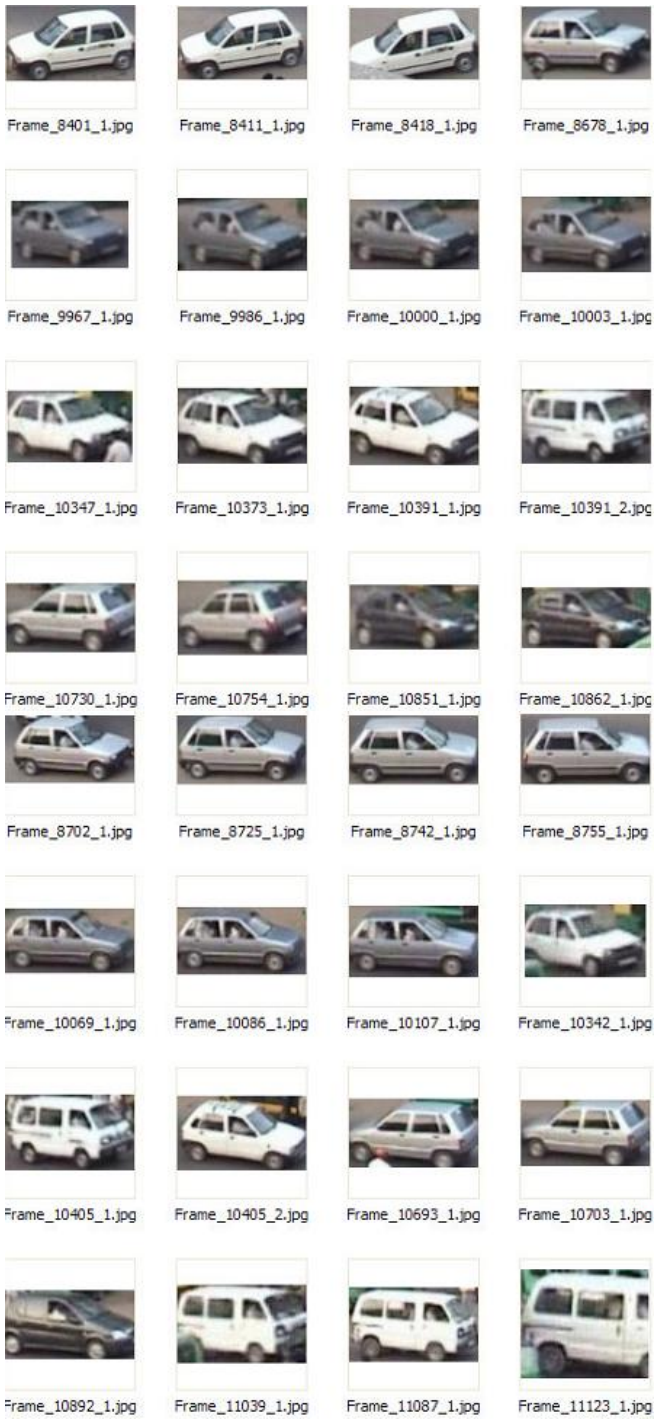

Fig. 1. Positive sample for classifier training

V. Implementation of Algorithm

Implementation of algorithm for detection and tracking a vehicle is as follow:

```
PointBeingTracked=ObjectList={}
Classifier=CAR CLASSIFIER
while(readNew(Image))
Detection_Vector=detect cars using classifier
For each detection in Detection_Vector
Detection_Matched=0
Find salient features for this detection and store it in PT
For each object in objectList
   If object point lie in Detection. Window
[1]  Delete all points of that object from
     PointBeingTrackedList
[2]  Add the list PT as feature of this object
[3]  Detection_ Matched=1
   If (!Detection_ Matched) //we have found something new
1)   Create new object
2)   Add the list PT as feature of this object
```

VI. Results

Frame Rates:
Car detection only: 16-18 frames/sec
Car detection & counting: 9 frames/sec

TABLE I: Vehicle Detection Result

Type	Detection (in a representative set of 276 images)
True Positive	143
True Negative	68
False Positive	05

Fig. 2. Detection of object from vedio1

Fig. 3. Detection of object from vedio2

Fig. 4. Detection of object from vedio3

VII. Further Work

The detection results can be further improved by training the classifier on largerset of positives and negatives. The direction of flow can be further used to improve tracking results as sudden changes in flow can be classified as cases of occlusion and such points can be ignored in the trackingalgorithm.

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Chirag I. Patel is pursuing Ph.D. in computer science & engineering from Nirma Institute of Technology, Ahmedabad, Gujarat, India. He received B.E. in Information Technology Engineering from A.D.Patel Institute of Technology, New VallabhVidyanagar, Gujarat, India, in 2006, and the M.Tech. in Computer Science & Engineering from Nirma Institute of Technology , Ahmedabad, Gujarat, India in 2009. His research interests are in video processing, statistical image processing and 3D vision.

Ripal Patel obtained the B.E. degree in electronics & communication engineering from A.D.Patel Institute of Technology, New Vallabh Vidyanagar, Gujarat, India, in 2006, and the M.E. in electronics & communication Engineering from Dharamsinh Desai University, Nadiad, Gujarat, India in 2009. Her research interests are Computer Vision, Texture Classification, Video Processing and Image Registration.