Advanced Automobile Recognition Through the Use of Image Processing Techniques

Andrew W. Stebbins
TJHSST
Alexandria, Virginia

January 24, 2008

Abstract

Many law enforcement agencies have recently shown interest in automated automobile recognition and tracking technologies such as license plate reading or GPS tracking. However, some criminals may drive vehicles that have false license plates or are not equipped with GPS tracking devices, making the pursuit of such vehicles difficult. This project aims to create a computer vision system capable of taking real-time input from a static camera and identifying passing cars by make and model in order to assist law enforcement agencies in the tracking of suspect or stolen vehicles. Vehicle identification is accomplished using a combination of old and new algorithmic image processing techniques.

Keywords: Canny edge detector, Hough transform, artificial neural network

1 Introduction

Many law enforcement agencies, especially ones in large metropolitan areas, are faced with difficulties when tasked with finding one specific car in a city of thousands. For example, a police officer may receive breaking news of a robbery underway, arrive late at the scene, and then have to chase the getaway car provided only with a witness's visual description of the vehicle.

Existing car-tracking technologies such as License Plate Recognition (LPR) would fail in this case, as the officer does not know the license plate number of the vehicle driven by the suspects who he is attempting to apprehend. It is in cases like these that an automatic visual automobile recognition system may prove useful. Thus, this project is primarily aimed towards assisting law enforcement agencies with chasing down criminals or recovering stolen cars.

2 Background

Several computer systems currently exist for the tracking of military and civilian automobiles via License Plate Recognition (LPR) or GPS technology. Such systems are in use by law enforcement entities such as US Customs and Border Protection[1] and UK police[2], and have proved very effective in catching criminals. However, these systems fail when an automobile has fake or no plates, and no GPS tracking device, and is able to avoid recognition. The new system outlined in this paper, on the other hand, is able to alert law enforcement officers of the presence of any specific type of vehicle regardless of whether or not it is equipped with GPS or the proper license plates, assisting in situations such as when an all-points bulletin is put out for a certain vehicle based only on a visual description. In addition, some systems already exist[3] that can automatically recognize military vehicles such as tanks by their color, size, geometric description. However, in the course of my preliminary research I found no complete existing systems capable of the automated, advanced (ie make and model) recognition of everyday civilian vehicles such as cars, small trucks, semis, etc. The inner workings of my system will be similar to that of the existing systems for the automated detection of military vehicles, in that it will define a certain set of characteristics for comparison, extract those characteristcs from the image of an unknown vehicle, and search amongst a list of characteristics known to belong to certain vehicles for a possible match. The primary difference between these types of systems and my own is that mine will be much more precise in terms of characteristics such as size and shape, and select possible matches from a much more diverse database.

3 Region of Interest Identification

This part of my program has not yet been implemented, but will utilize movement tracking to identify areas of an image that are in motion in order to differentiate a moving car from static background clutter. The purpose of identifying the region of interest in an image that contains a car is to remove background clutter and make it easier for the object classification algorithm to correctly recognize key features and important points or vertices. Movement tracking is a commonly used and reasonably accurate method for obtaining such a region of interest[5].

4 Object Classification

This part of my program has not yet been fully implemented, but will focus on recognizing and classifying key distinctive features from the image of an automobile. Such features may include color, size, shape, and the location of key points or vertices. Currently, I have implemented edge, line, and vertex detection, underlying building blocks for any advanced feature recognition algorithm. I have looked into neural networks as an intuitive, learning-based method of automobile classification; my conclusion was that they would not be appropriate for an object categorization task of such complexity. The set of training example images would need to be immense for a neural network-based automobile recognition program to attain any acceptable level of accuracy.

5 Results and Discussion

Unfortunately, my project does not yet exist in the form of a single program able to be tested on its ability to detect and recognize automobiles in video segments. The various components of my program currently perform as expected, accurately detecting lines, recognizing handwritten characters, and displaying video input. The frame rate of my streaming input viewer is somewhat low, a problem which will have to be addressed before accurate motion detection can be attempted. I hope to be able to test an assembled version of my final program on short video segments of cars in motion by the end of the third quarter.

References

[1] "LPR technology makes recording license plates a snap." U.S. Customs Today. 27 October 2007 http://cbp.dhs.gov/xp/CustomsToday/2001/December/custoday_lpr.xml

[2] "Number plate scanners hit crime." BBC News. 27 October 2007 http://news.bbc.co.uk/2/hi/uk_news/england/berkshire/4553469.stm

[3] Dalley, Gerald. "Vehicle Recognition in Cluttered Environments.", 2002. http://people.csail.mit.edu/dalleyg/presentations/MSThesisPresentation.ppt (October 27, 2007)

[4] Ferencz, A. et al., "Learning Hyper-Features for Visual Identification", 2004. http://www.eecs.berkeley.edu/Research/Projects/CS/vision/shape/papers/ferencz-nips04.pdf (October 27, 2007)

[5] Dlagnekov, L. et al., "Recognizing Cars", 2004. http://www.cse.ucsd.edu/classes/fa05/cse252c/dlagnekov_belongie.pdf (January 2, 2007)