Exploring Methods For Car Recognition

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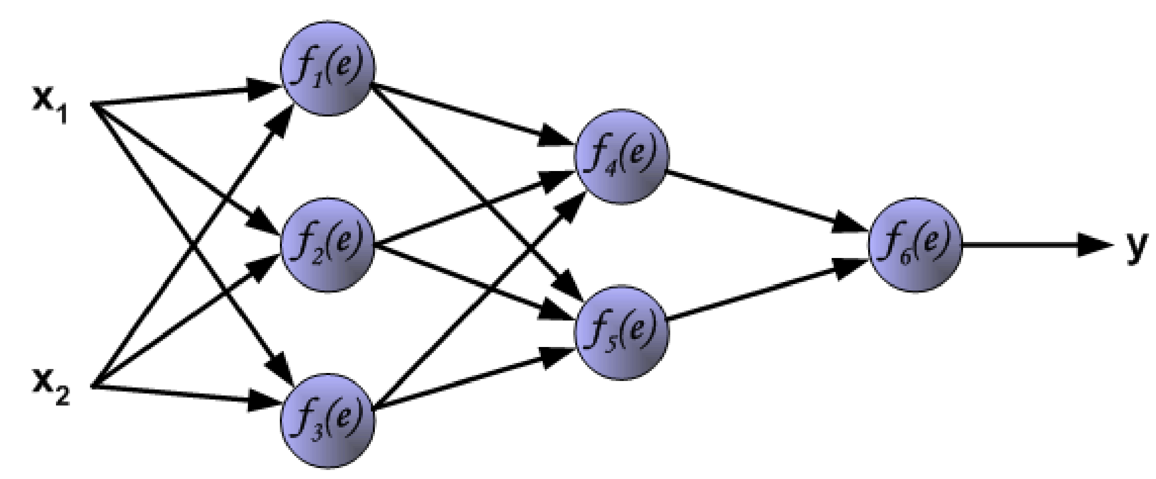
Abstract

Many law enforcement agencies have recently shown interest in automated automobile recognition and tracking technologies such as license plate recognition (LPR) 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 or impossible. 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.



Simple neural network

Background

Much research has been done on the topic of generalized computer-based object recognition through the use of techniques such as the Viola-Jones face recognition algorithm and David Lowe's Scale Invariant Feature Transform (SIFT) keypoint matching method. Dlagnekov and Belongie, at the University of California, San Diego, have made an attempt at a car recognition system based off of region of interest (ROI) identification through the use of LPR and actual object recognition through the use of SIFT keypoint matching. They recorded a successful recognition rate of 89.5% on their query set of 38 images using a database of 790 images of known make and model. Two other object recognition and categorization techniques, neural networks and the Hough transform, have been used on simpler object classes with limited success.

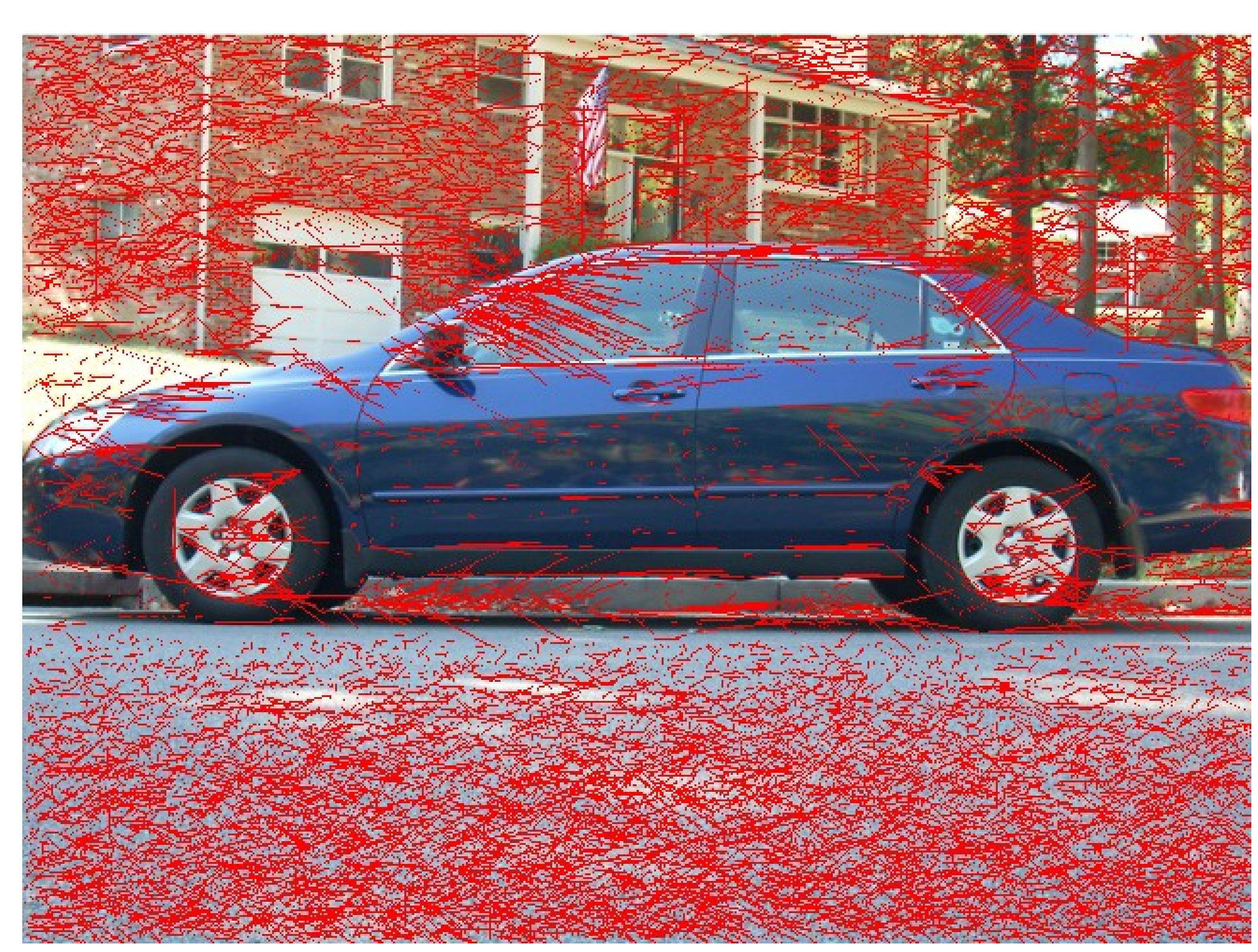
Procedure and Methods

My program processes images of cars taken in side profile, unlike the rear angle from which all images used by Dlagnekov and Belongie were captured. Currently, my program can determine the proper ROI in an image by locating a car's wheels through the use of the Hough circle transform, and locate all SIFT keypoints as local extrema of the difference of Gaussian, a function of scale space. Scale space extrema are detected by comparing the difference in the value of a pixel at one scale to the value of the pixel in the same place at another scale to that same value at all of the locations adjacent to that pixel in all current and neighboring scales. The Hough transform-based circle detector makes multiple passes through Hough space for each possible car wheel radius, searching for the highest Hough space intensity values in each side of the image.

ROI detected using Hough transform

My exploration of neural networks as a possible method of car recognition showed that while neural networks are suitable for simple types of object recognition such as optical character recognition, or OCR, they are unsuitable for a task as complex as car recognition due to the hundreds of thousands of variables involved in each image of a car.

I have also developed a separate program to receive and process real-time input from a USB webcam attached to a Linux computer. This program allows the user to freeze any given frame and apply any given code to the captured frame in order detect the model and make of each car located within the camera's view at that particular moment.



Detected SIFT keypoints displayed as vectors based on image gradient magnitude/direction

Results

My Hough transform-based ROI detection algorithm currently performs very well on images of cars with wheels of any size, as long as the amount of random noise is kept below a certain threshold. Above a certain noise level, the extra edge pixels detected by the Canny edge detector make accurate wheel detection nearly impossible. My implementation of the SIFT keypoint matching algorithm was %80 complete by the end of the school year. From my research and the results of my SIFT keypoint detection algorithm, it seems that a local features-based car recognition method such as the SIFT transform would be the best method for real-time or near real-time car recognition.