



AUTOMATIC LICENSE PLATE LOCATION AND RECOGNITION ALGORITHM FOR COLOR IMAGES

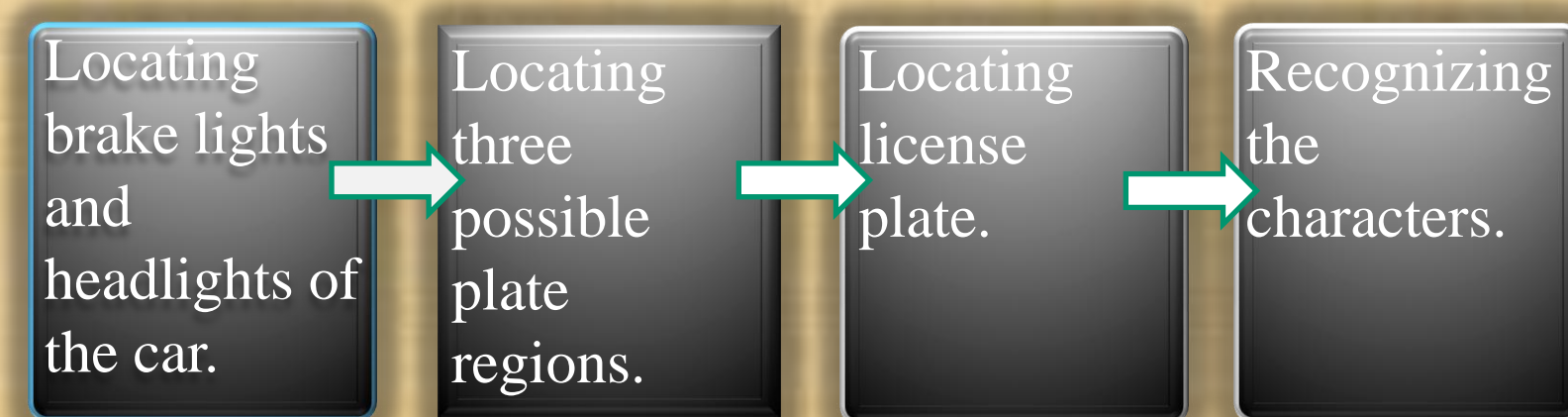


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Abstract

An automatic car license plate location and recognition system has a great importance in today's industrial world for intelligent transport systems. Any automatic license plate location and recognition system has two main stages: (1) the license plate location and (2) the license plate recognition (LPR). The license plate location is the most important stage in the LPR systems which affects the system's accuracy, directly. Most of the previous methods are based on gray images but the color information is also an important factor to locate the license plate. In this project, we propose a novel license plate location algorithm for color images. The proposed algorithm is based on the brake lights and headlights of car. At the recognition stage, a well known and accepted character recognition algorithm has been used.



The flow chart of the automatic license plate location and recognition system.

Introduction

Automatic license plate location and recognition is an area on the demand. It has many applications in industry, particularly for intelligent transport systems. Recently, a nine-hundred-million-dollar-worth project called "PROMETHEUS: Program for European Traffic with Highest Efficiency and Unprecedented Safety" has been conducted in the area of car plate recognition. This project includes six European countries. The aim of the PROMETHEUS project is to chase the cars and give ticket to the drivers by recognizing the license plate. This project is a great example showing the importance and the popularity of this area. Since the license plate recognition has great significance in industry, there are not much published researches.

Locating the License Plate

Since, the license plate has to be located around lights of a car as shown in Figure 1; we should focus on these regions. The specific knowledge about brake lights of a car is the fact that they have to be red; indeed headlights of a car have to be white. Therefore the desired pixels on these regions have been set to intensity value of 1 and the others have been set to 0 as shown in Figure 2. The image has been scanned by the 40 by 40 blocks and the regions where the mean value of the block is greater than the threshold value, which is set automatically by the algorithm, has been set to 1 as shown in Figure 3. Afterwards, the white pixels whose right neighbor pixel is black and the black pixels whose right neighbor pixel is white has been found as shown in Figure 4. The coordinate with the maximum row number is thought to be as the initial point.



Figure 1. The car image



Figure 2. The area where the intensity level of red pixel is the greatest



Figure 3. The scanned blocks



Figure 4. Edge detection

From this point the image has been cropped. In this way, we end up with three possible plate location segments from the image as shown in Figure 5. In order to select the image which contains license plate Sobel edge detection algorithms have been applied.

Locating the License Plate – cont'd.

Pixels of each edge matrix were examined and it is observed that some pixels are common in both of edge matrices. Letters in plates have the greatest number of common pixels, so it is readily inferred that the image that contains the greatest number of common pixels is the image that contains the license plate. Figure below illustrates vertical and horizontal edges of a car image respectively where common pixels are in the license plate area. At this point, the cropping process has been applied to obtain the exact location of the license plate. Horizontal and vertical edge matrices are added together and the standard deviation of the each pixel is calculated. The area where the standard deviation value is the greatest said to be the area of the license plate and that area has been cropped as shown below.

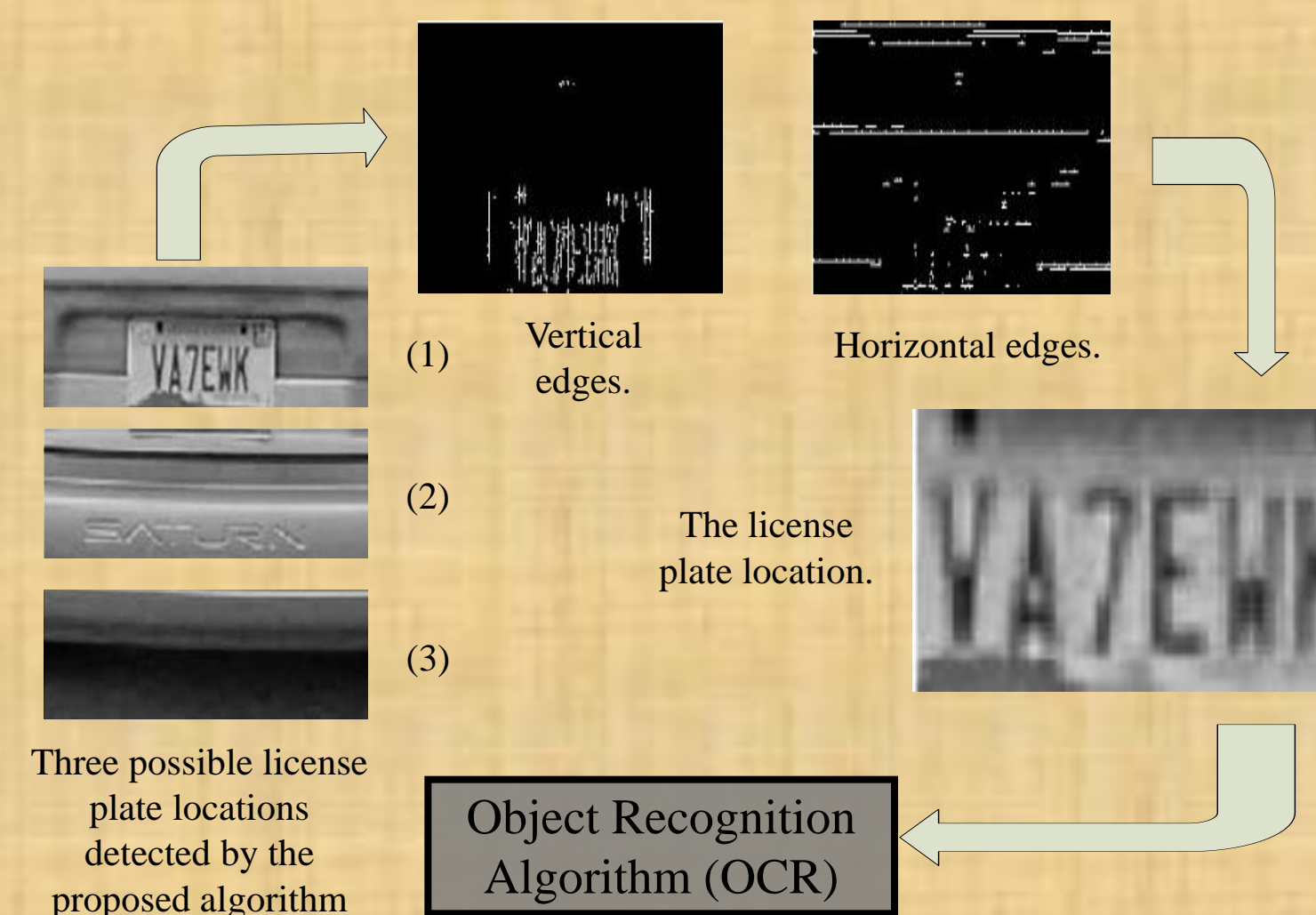


Figure 5. The license plate location process

Character Recognition Algorithm

Through the character recognition process the letters from A to Z and the numerical values from 0 to 9 have been stored as templates. Each letter in the template has been converted into 42x24 pixel binary image. In order to proceed one letter next in the line, the connected components of the pixels have been labeled. So that, each character has been separated accurately. In other words, the characters which have continuous strokes have been separated from another character.

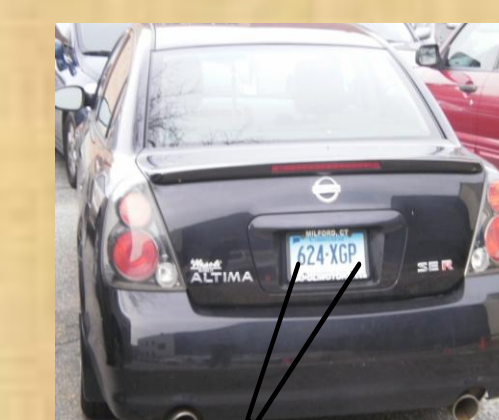
Character Recognition Algorithm

The main operation used for classification is the correlation in two dimensions. This operation gives the value of similarity of two arrays by using the following equation. By looking this value, the correct character has been determined.

$$r = \frac{\sum_m \sum_n (A_{mn} - \bar{A})(B_{mn} - \bar{B})}{\sqrt{(\sum_m \sum_n (A_{mn} - \bar{A})^2)(\sum_m \sum_n (B_{mn} - \bar{B})^2)}}$$

Discussion and Results

In this project we have presented an algorithm based upon color information of the car lights. The advantage of such a system is high success rate in locating the license plate since the light color of every car has to be red. The system gives good results for the car images taken from 2 to 3 meters and under the day light. In this research we used car images. Our database includes 600 images taken from various scenes including diverse angles, different lightening conditions. *Experimental results demonstrate the great robustness and efficiency of our method for small vehicles. We present some of the results below.*



The OCR output is 624XGP.



The OCR output is 653XGZ.



The OCR output is IHA. Due to the long distance the result is not accurate.



The OCR output is 891UAH.