

# Automatic Garage Door Opening Using License Plate Recognition and Fingerprint Verification

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**ABSTRACT:** A novel computer vision system is proposed in this paper for the automatic identification of vehicles. This system uses License Plate Recognition (LPR) technique for the automatic identification. This system can be used as a complementary verification stage to the existing access control systems for a garage entrance. Using a camera in the door, cars are detected and matched to the database of authenticated cars. Histogram of Oriented Gradients (HOG) technique is used for object detection. Once a car is detected, License Plate Recognition (LPR) is applied using character detection and recognition. The found license plate number is matched with the database of authenticated plates. In this paper, the computer vision system is implemented in an embedded platform by adding fingerprint verification system. If the license plate and fingerprint of the user is matched, the vehicle will get access and the door will open automatically.

**KEYWORDS:** Computer vision, Fingerprint verification, Histogram of oriented gradients (HOG), License plate recognition (LPR), Optical character recognition (OCR).

## I. INTRODUCTION

COMPUTER vision is a field that includes methods for acquiring, processing, analyzing, and understanding images and, in general, high-dimensional data from the real world in order to produce numerical or symbolical information. The fields most closely related to computer vision are

image processing, image analysis and machine vision. Typically Automatic garage door opening is implemented by use of a radio receiver and transmitter.

When arriving in the neighborhood of the garage, the user presses a button on the transmitter and a radio signal is sent to the receiver inside the garage.

The receiver then verifies the signal and opens the garage door. Multiple persons can make use of this system by configuring multiple radio transmitters. The use of such a system poses a security issue, which evolves from many possible situations that finally lead to unauthorized access. There are situations such as the radio transmitter can be stolen or lost, the radio code can be captured and reproduced with a specialized receiver, or codes can be tested within a certain neighborhood to find matching locations. In such situations, the total system needs to be reconfigured.

These types of automatic access control systems that are currently available on the market uses only a radio signals for verification of the user. Visual checking of the identity of the car is lacking in these systems. So this type of access control systems does not provide complete security.

In this project work, we propose a computer vision system that works as part of an intelligent access control system for a garage entrance. This provides automatic identification of vehicles. This system uses computer vision technology for the verification of the user's vehicle and is operating as follows.

A camera is installed in the garage, having a clear view of the driveway. Object recognition technology is used to detect and verify the user's car. First, a car detector is used to detect the presence of any car in front of the door. As soon as a car is detected, a description of the car is generated and this description is matched to the database of allowed vehicles for verification. In addition, a second verification stage is applied.

The car license plate is recognized and matched to the set of allowed plates. If both the car and the license plate are authenticated, the garage door will be opened. For additional security, an alarm may be generated as soon as someone

with a non-authorized car, but with the same plates appears. This system uses detection and recognition of visual objects.

The purpose of this project was to build a real time application which recognizes license plates from cars at a gate, for example at the entrance of a parking area. The system, based on regular PC with video camera, catches video frames which include a visible car license plate and processes them.

Once a license plate is detected, its digits are recognized, displayed on the User Interface or checked against a database. The focus is on the design of algorithms used for extracting the license plate from a single image, isolating the characters of the plate and identifying the individual characters.

Our approach does not require a special License Plate Recognition (LPR) camera, although this can be advantageous in cases with extreme glare from the sun. In contrast to typical LPR systems, we embed a car detector to avoid authentication when someone just makes a copy of the user's license plate and holds this for the camera. Recognition should be applied to images captured by a low-cost camera. Moreover, because the system should also function reliably during low-light conditions (at night), color information cannot be used.

The system should detect and authenticate the car upon entering the driveway and approaching the door. This results in a time requirement of only a few seconds for the recognition process.

The object detection problem is typically highly asymmetric, because of the limited variation in object appearance (few samples), compared to the background as this can be anything (many samples). When a car is detected, the image is forwarded to the LPR module, that extracts the license plate.

The algorithm works in three stages. First, individual text characters are detected. Second, the detected characters are recognized: each character is classified into the set of known characters from an alphabet (OCR). Third, the individual characters are merged into words. The found words are sent to the verification module to perform the actual authentication.

Multiple cars might be authorized by the system, for example, when the system is deployed in a private parking, where multiple cars are parked. Therefore, the system should detect all objects in the category car and not be limited to the detection of the specific user car. For the application considered in this paper, we detect cars and should verify the car type by comparing it to the database without classifying the brand and color, etc. In this paper, we discuss the detection of cars and license plates. Additionally, we design a plate verification step that recognizes the text on the plate.

## II. RELATED WORK

In this paper, we proposed a computer vision system, which uses License Plate Recognition (LPR) for the identification of vehicles as part of an intelligent access control system. The system works as follows. A camera is installed in the garage, having a clear view of the driveway. Object recognition technology is used to detect and verify the user's vehicle. In this, first video is captured by the "camera" in the garage door. Then "vehicle detection" is applied in each video frame. Once a vehicle is detected, a description of the vehicle is extracted and sent for "vehicle verification".

In conjunction, the location of the vehicle is sent for the "plate recognition" stage. In this stage, the system localizes and recognizes the license plate of the vehicle. Once a plate is found, the characters are sent for the "plate verification" stage. Once both verification modules send out a signal of verification, then the system checks if the car matches the plate. If the user has been fully verified, the garage door will be opened.

In this system, Histogram of Oriented Gradients (HOG) technique is used for object detection. Histogram of Oriented Gradients is feature descriptors used in computer vision and image processing for the purpose of object detection. The technique counts occurrences of gradient orientation in localized portions of an image.

This method is similar to that of edge orientation histograms, scale-invariant feature transform descriptors, and shape contexts, but differs in that it is computed on a dense grid of uniformly spaced cells and uses overlapping local contrast normalization for improved accuracy.

Optical Character Recognition(OCR) is used for license plate recognition.OCR is used for identifying characters in images of printed or handwritten text, usually with a view to encoding the text in a format more amenable to editing or indexing. That is, optical character recognition is the method used by a computer to convert scanned in pages of text into electronic text documents.

License Plate Recognition is the method used by a computer to convert digital images of vehicle license plates into electronic text. This is mainly used for character recognition from the images and this technique is mainly used in image processing.

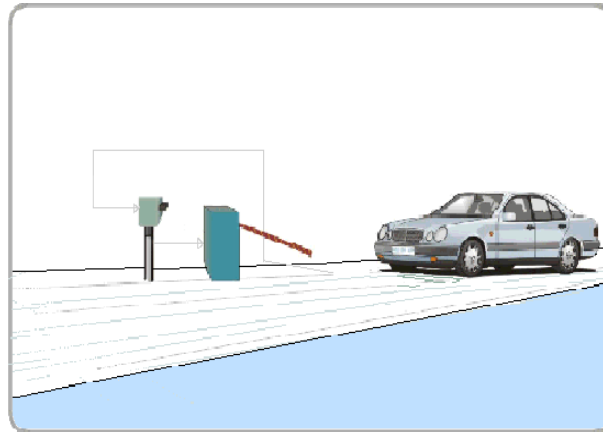


Fig.1. A typical representation of the system.

Automatic video analysis from urban surveillance cameras is a fast-emerging field based on computer vision techniques. Several monitoring objectives such as congestion, traffic rule violation, and vehicle interaction can be targeted using cameras that We present here a comprehensive review of the state-of-the-art computer vision for traffic video with a critical analysis and an outlook to future research directions.

This field is of increasing relevance for intelligent transport systems (ITSs). were typically originally installed for human operators. Systems for the detection and classification of vehicles on highways have successfully been using classical visual surveillance techniques such as background estimation and motion tracking for some time.

Automatic license plate recognition (LPR) plays an important role in numerous applications and a number of techniques have been proposed. However, most of them worked under restricted conditions, such as fixed illumination, limited vehicle speed, designated routes, and stationary backgrounds. In this study, as few constraints as possible on the working environment are considered.

The proposed LPR technique consists of two main modules: a license plate locating module and a license number identification module. The former characterized by fuzzy disciplines attempts to extract license plates from an input image, while the latter conceptualized in terms of neural subjects aims to identify the number present in a license plate. Experiments have been conducted for the respective modules.

An algorithm for license plate recognition (LPR) applied to the intelligent transportation system is proposed on the basis of a novel shadow removal technique and character recognition algorithms.

This paper has two major contributions. One contribution is a new binary method, i.e., the shadow removal method, which is based on the improved Bernsen algorithm combined with the Gaussian filter. Our second contribution is a character recognition algorithm known as support vector machine (SVM) integration.

In SVM integration, character features are extracted from the elastic mesh, and the entire address character string is taken as the object of study, as opposed to a single character.

This paper also presents improved techniques for image tilt correction and image gray enhancement. Our algorithm is robust to the variance of illumination, view angle, position, size, and color of the license plates when working in a complex environment.

The algorithm was tested with 9026 images, such as natural-scene vehicle images using different backgrounds and ambient illumination particularly for low-resolution images.

Shape descriptors are some set of numbers that are produced to describe a given shape. License plate recognition (LPR) algorithms in images or videos are generally composed of the following three processing steps: 1) extraction of a license plate region; 2) segmentation of the plate characters; and 3) recognition of each character. This task is quite challenging due to the diversity of plate formats and the non-uniform outdoor illumination conditions during image acquisition. Therefore, most approaches work only under restricted conditions such as fixed illumination, limited vehicle speed, designated routes, and stationary backgrounds.

### III. PROPOSED WORK

Computer vision is a technology used for processing & analyzing images. In this section, we have implemented the computer vision system for identifying vehicles along with an embedded platform for the automatic garage door opening. In this, an alarm is also added in order to provide additional security. That is, this will alert us as soon as someone with a non-authorized car, but with the same plates appears. This will overcome the drawback of the existing system described above.

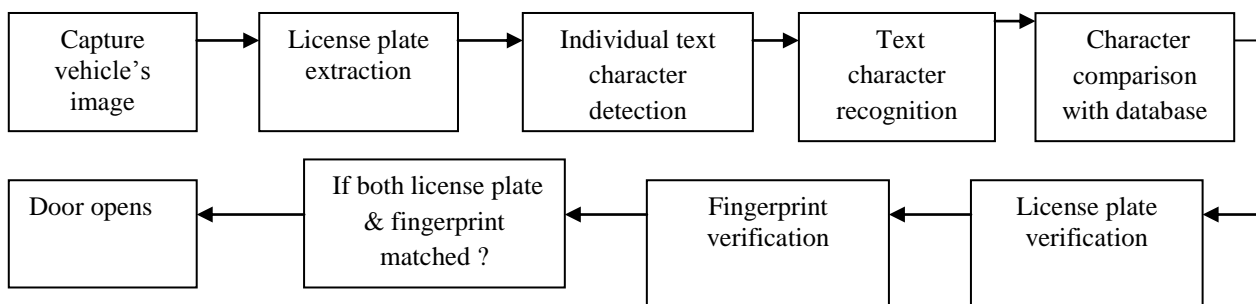


Fig.2. Overview of the processing blocks in the system.

The block diagram of the entire system along with the hardware platform is shown above. When the vehicle enters the driveway of the garage, an image of the vehicle will be generated. Then the license plate recognition is done.

#### 3.1. License Plate Recognition (LPR)

License plate recognition (LPR) algorithms in images or videos are generally composed of the following three processing steps:

- 1) Extraction of a license plate region
- 2) Segmentation of the plate characters
- 3) Recognition of each character.

From the captured image, the license plate region is extracted. Then the segmentation of the characters is performed. After that individual text characters are detected and then these detected characters are recognized. Finally these individual characters are grouped into words. Then this word is matched with the database of authenticated license plates. If the license plate is verified, then the garage door will be opened.



Fig.3.a. Locating the license plate on a digital image

of a vehicle.



Fig.3.b. Segmenting the characters of the license plate.



Fig. 3.c. Recognizing each character.

**Fig.3.** Different processing steps of the License Plate Recognition.

The license plate is verified using different processing steps. Figure.3 shows these different processing steps of the license plate recognition.

### 3.2. Hardware Module

The proposed computer vision system has also been implemented and evaluated on an embedded platform. This uses a Peripheral Interface Controller, 16F877A and mikroC, mikro Elektronika C compiler software, which is used for compiling Microchip PIC microcontrollers.

### 3.3. Fingerprint Verification

The proposed system includes the fingerprint reader for the finger print verification and the LCD module to display the results of fingerprint and license plate recognition. This system also includes the USART interface for the fingerprint system.

## IV. EXPERIMENTAL RESULTS

This section describes the implementation of the proposed computer vision system on a DIP based real-time system. We conducted various representative real-time experiments to evaluate the vehicle detection and classification performance obtained by the proposed system. The proposed real-time vision system was implemented on a DIP-based embedded platform. The proposed system was tested on several images of real vehicles in various situations for security, other traffic and parking applications.

Fig.4 shows the results of the experiments which were tested on a garage entrance for identification of vehicles. In the Fig. 4.a. the image, other than a vehicle is loaded. Then it gives the result as “car not identified”.

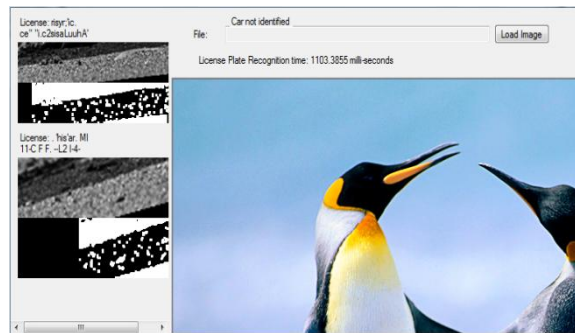


Fig.4.a. Gives the result as vehicle not identified, when an image other than vehicle is loaded.



Fig.4.b. Image of a car is loaded.

After that, the image of a car is loaded (fig.4.b). Then it started the processing of the license plate characters. Finally when the license plate is matched to the database of authenticated license plates, it shows that “license detected & garage door opened” (fig.4.c).

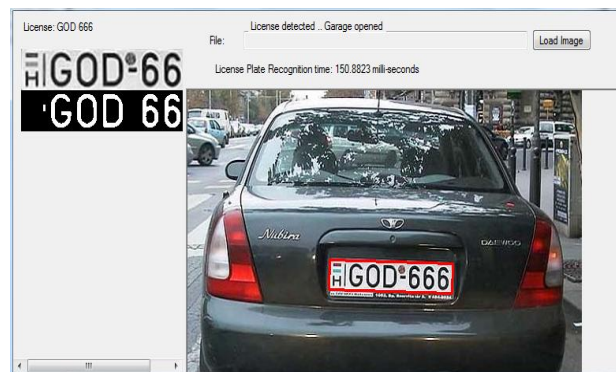


Fig.4.c. License plate number is verified.



		P7577
		G4402
		DU3403
		GG4025
		CX0166
(a)	(b)	(c)

Fig.5. Examples of successful license number identification: (a) located license plates, (b) character segmentation, and (c) license number identification.

Experiments have revealed that 90% of all cars are correctly authenticated from a single image only. Main causes for incorrect recognition are very dirty Plates.

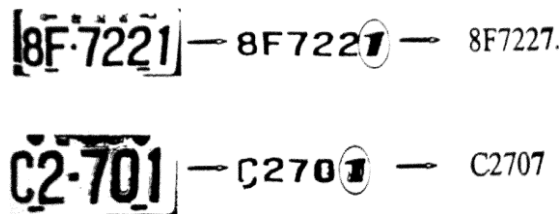


Fig.6. Examples of failed license number identification

These performance measures are obtained with single images only. The real application would benefit from using multiple frames for the analysis.

## VI. CONCLUSION

In this paper, we have presented a novel computer vision system for the identification of vehicles as part of an intelligent access control system. In this, we have also implemented and evaluated the system in an embedded platform. The fingerprint verification system added along with the hardware implementation provided additional security. The proposed system provides user verification also. This overcomes the drawback of the existing system. The proposed implementation system was tested with different images of vehicles. Our system shows that all cars are detected with only a few false detections, which does not influence the authentication performance. Experimental results have shown that the proposed system is effective and offers advantages for vehicle identification in various applications.

## REFERENCES

- [1] Rob G. J. Wijnhoven and Peter H. N., Identity Verification Using Computer Vision For Automatic Garage Door Opening”, IEEE Trans. on Consumer Electronics, vol.57, no. 2, May. 2011.
- [2] C.N.E. Anagnostopoulos, I. E. Anagnostopoulos, V. Loumos and E. Kayafas, “A License Plate- Recognition Algorithm For Intelligent Transportation System Applications”, IEEE Trans. on Intelligent Transportation Systems, vol. 7, no. 3, pp. 377-392, Sept. 2006.
- [3] C. D. Nguyen, M. Ardabilian and L. Chen, “Robust Car License Plate Localization Using a Novel Texture Descriptor”, Proc. IEEE International Conference on Advanced Video and Signal based Surveillance (AVSS), pp. 523-528, Genova, Italy, Sept. 2009.
- [4] F. Porikli and T. Kocak, “Robust License Plate Detection Using Covariance Descriptor In A Neural Network Framework”, Proc. IEEE Int. Conf. on Advanced Video and Signal Based Surveillance (AVSS), Nov. 2006.
- [5] S. Chang, L. Chen, Y. Chung and S. Chen, “Automatic License Plate Recognition”, IEEE Transactions on Intelligent Transportation Systems, vol. 5, no. 1, pp. 42-53, Mar. 2004.
- [6] J. J. Weinman, E. Learned-Miller and A. R. Hanson, “Scene Text Recognition Using Similarity And A Lexicon With Sparse Belief Propagation”, IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI), vol. 31, no. 10, pp. 1733-1746, Oct. 2009.
- [7] B. Leibe, A. Leonardis and B. Schiele, “Robust Object Detection With Interleaved Categorization And Segmentation”, International Journal of Computer Vision (IJCV), vol. 77, no. 1, pp. 259-289, May 2008.
- [8] N. Dalal and B. Triggs, “Histogram of Oriented Gradients For Human Detection”, Proc. IEEE Conference on Computer Vision and Pattern Recognition (CVPR), vol. 1, pp. 886-893, June 2005.
- [9] M. Everingham, L. V. Gool, C. K. I. Williams, John Winn and A. Zisserman, The PASCAL Visual Object Classes (VOC) Challenge, International Journal of Computer Vision (IJCV), vol. 88, no. 2, pp. 303-308, Sept. 2010.
- [10] T. E. de Campos, B. R. Babu and M. Varma, “Character Recognition In Natural Images”, Proc. International Conference on Computer Vision Theory and Application (VISAPP), pp. 273-280, Lisboa, Portugal, Feb. 2009.