

License plate recognition software

*FSoft-LPR*

# Specifications

Version 1.3

## Contents

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This document is divided into three parts :

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## Introduction

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The aim of this license plate recognition software is to extract Swiss license plate numbers out of a picture. This image processing system has two main parts:

- searching of the plate in the picture
- recognition of the characters on the plate

### Use

The targeted companies for this software are the ones that work in traffic flux management (for example : police, parking, customs, etc...).

### Situation

Radar pictures present two difficulties. The first is the small dimensions of the Swiss license plates. The second and most difficult one, is the changing environment in which the pictures are taken (e.g. car position, weather conditions).

The dimensions and the quality of a plate picture are dynamical parameters that have to be limited in order to allow for a good recognition.

## Software presentation

The software developed by FiveCo allows the user to extract the characters of a license plate from a picture or a video stream.

In practical terms, the input is a picture (jpeg or bitmap format) and the output is the license plate number and the error probability.

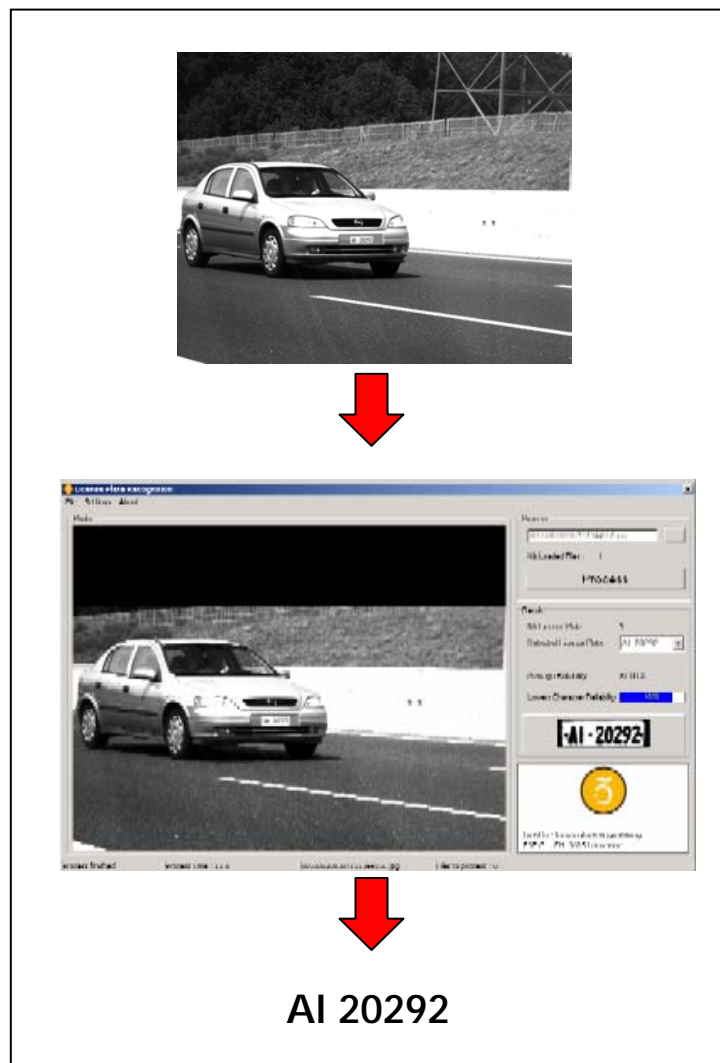


Figure : software principle

From an image processing point of view, the algorithm is done in three steps :

- License plate localization in the picture (contrast, line extraction ...)
- Horizontal plate position correction (rotation if necessary)
- Characters extraction through a special pattern matching method

Without going through technical details, it is interesting to understand how pattern matching works. The next illustrations show the pattern 6 moving on the VD52691 plate.

In fact, more there are red pixels, more the similarity is high.

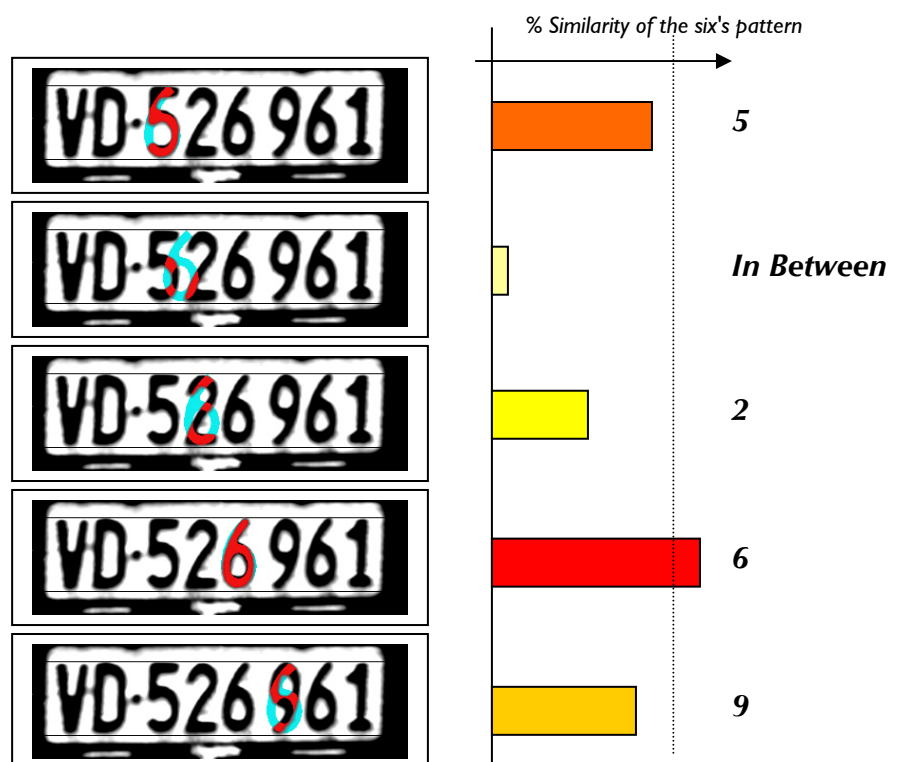


Figure : Principle of use of character patterns.

The parameters  $P_c$  is the Similarity in percent between one character and its pattern. For example, the results for the preceding plate are :

<i>Position</i>	1	2	3	4	5	6	7	8
<i>Best Characters</i>	<b>V</b>	<b>D</b>	<b>5</b>	<b>2</b>	<b>6</b>	<b>9</b>	<b>6</b>	<b>1</b>
$P_c$	93%	95%	96%	97%	96%	94%	95%	95%

The result of the detection is completed by two numbers in percent to qualify the recognition of the character on the plate :

- The percentage  $P_d$  is the worst character detection. In fact the character with the smallest recognition percent with its pattern of the whole plate. In the example VD526961,  $P_d$  is equal to 93% (=character V).

$$P_d = \min\{P_{c1}, P_{c2}, \dots\}_n$$

$n$  : Number of characters on the plate.

- The percentage  $P_m$  is the average of the  $P_c$ . In the example VD526961,  $P_c$  is equal to 95%.

$$P_m = \text{average} \{P_{c1}, P_{c2}, \dots\}_n$$

## Results

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A plate is recognized only if  $P_d$  and  $P_m$  are high. To evaluate the good level of acceptability for those tow parameters, we have to process many images.

A set of results may be written as follows in an excel file.

File Name	Plate Nr	% Min (Pd)	% Average (Pm)	Founded Plate
005586200307151340561.jpg	VD466724	90.20	93.73	1
005586200307151342281.jpg	VD309221	87.45	92.89	1
005586200307151342431.jpg	VD353827	86.67	90.29	1
005586200307151344331.jpg	VD498143	87.06	91.91	1
005586200307151344511.jpg	VD131809	89.41	93.68	1
005586200307151344551.jpg	AI20292	87.84	92.06	1
005586200307151345431.jpg	GE99600	88.24	92.65	1
005586200307151345461.jpg	VD526961	82.75	91.03	1
005586200307151347071.jpg	AI66363	87.45	89.75	1
005586200307151347421.jpg	VD292792	90.59	95.01	1
005586200307151348111.jpg	VD394294	80.78	87.39	1
005586200307151348131.jpg	VD23132	87.45	90.78	1
005586200307151350221.jpg	VD334284	85.49	91.57	1
005586200307151350301.jpg	VD280573	89.80	92.70	1
005586200307151351001.jpg	VD281971	85.88	91.57	1
005586200307151351071.jpg	VD168294	89.02	91.81	1
005586200307151351541.jpg	VD27882	87.06	91.37	1
005586200307151352301.jpg	AG149334	88.24	92.84	1
005586200307151352411.jpg	VD12180	92.16	94.06	1
005586200307151353031.jpg	ZH153186	92.16	94.51	1
005586200307151353481.jpg	VD101714	80.78	89.22	1
005586200307151354081.jpg	VD248747	92.55	94.12	1
005586200307151354381.jpg	VD299589	91.76	92.75	1
005586200307151355251.jpg	VD270900	83.92	90.54	1
005586200307151355261.jpg	VD158916	87.06	91.23	1

Table : Example of results – Excel file.

## Software specifications

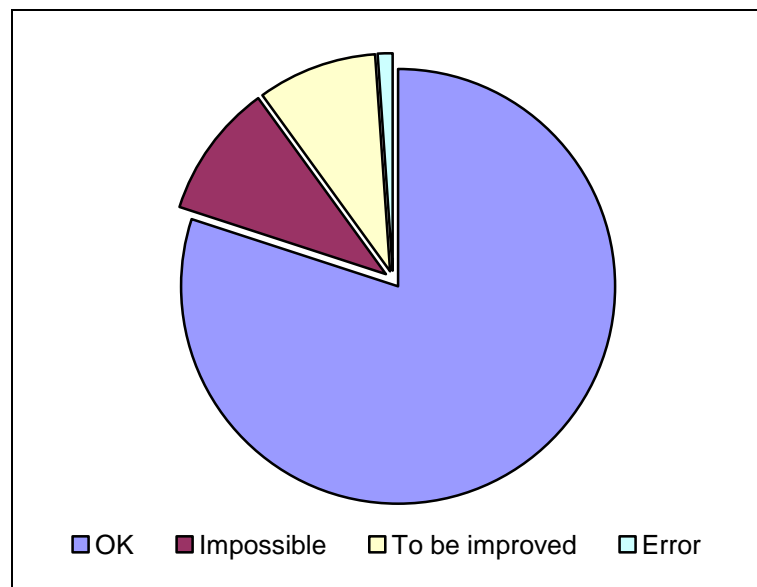
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The processing time needed to extract a plate number depends on the computer processor frequency, the picture resolution (height and width pixel size) and the complexity of the image. For example, the treatment of a radar picture taken by day takes on average 3.4 sec but in a parking, with a good lighting, the time fall down to 0.6 sec.

The software reliability is given by the recognition rate (how many plates are correctly found with no error on the character extraction) and the error rate (plate is found but an error on the character recognition has been made).

### Example of performance on Radar Pictures:

In case of pictures coming from **digital (police radar machines)**, the results (based on a sample of 100 pictures supplied by the "Police Cantonale Vaudoise") show a recognition rate of **80%** and an error rate of **1%**.



*Graphic : Software performance on radar pictures*

## Particular cases

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With the next cases, the software cannot extract the characters:



Detection of the "canton"  
difficult



The bolts and low resolution

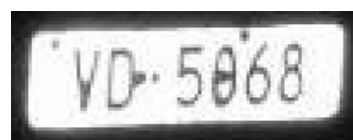




Damaged plate : 3 or 8 ?



A reflection crosses the plate



The 0 is confused with an 8 because of a bolt presence.

## Problems

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Of course, the radar pictures represent the “worst case” situation for the base parameters:

- Resolution/dimension of the plate
- Orientation of the plate
- Weather/light conditions  
(Quality of the plate pictures)

In the case of **controlled environment pictures** (inside a building, parking entries, covered spaces,...) the upper parameters are much more controlled and **the recognition rate approaches 98%**.

### Resolution

To be able to get good results, it is mandatory to have pictures in which the license plate height is at least 20 pixels. In fact, smaller resolutions do not allow a reliable extraction of the plate number.

## Advantages

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In comparison to the standard license plate recognition softwares that are present on the market, FiveCo's LPR software allows a wider range of camera position with regard to the car. In fact, most of the other softwares require that the camera be placed just in front of the car and they need a nearly controlled environment (light quality, car distance ...).

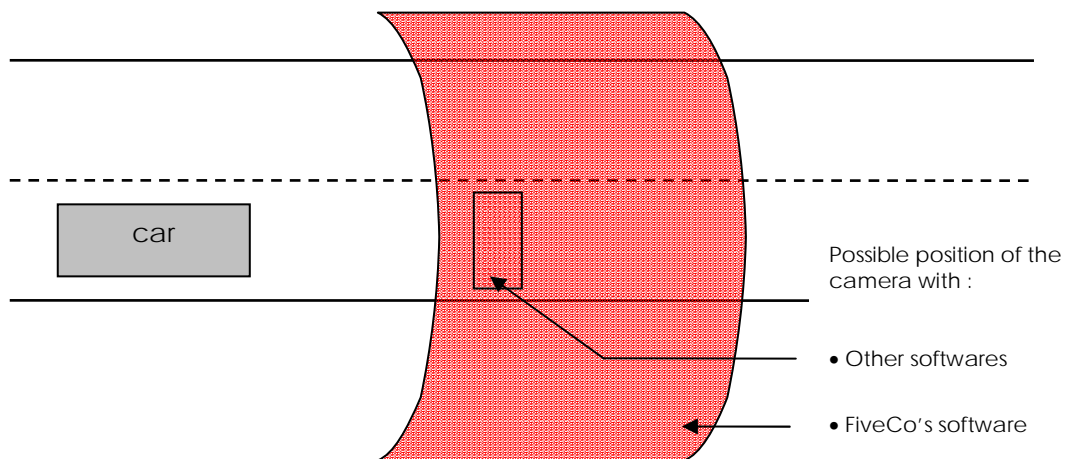


Figure : car position with regard to the camera.

- Based on that feature, the performance and the flexibility of the algorithm give it important adaptation capability and reliability advantages.
- This software is especially optimized for **SWISS plates** that have different and smaller characters than the European ones. The recognition of Swiss plates is then superior to currently available LPR systems.

## Software usage

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It's possible to modify the following parameters of the algorithm :

- Acceptation level for  $P_d$  and  $P_m$ .  
(Default value :  $P_d = 80\%$ ,  $P_m = 83\%$ )
- The interest area in the image where the plate is always located.

The system is conceived to process automatically big packages of images. At the end of the treatment, you only have to analyze manually the untreated pictures.

This software is a **C++ library** (DLL : C++ compiled program) with different entry and exit to integrate it easily in existing systems.

## Information

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For further information, please visit our website on the following url [www.fiveco.com](http://www.fiveco.com) under the following heading : >Projects>Internal Projects >License Plate Reco(LPR), or contact us by mail at [info@fiveco.com](mailto:info@fiveco.com) or by phone at the following number : +41 21 693 86 71.