Alpha-Numerals Recognition: Vehicle Number Plate Recognition (VNPR)

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By

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Abstract

Now a days vehicle play a vital role in transportation. Also the use of vehicles has been increasing because of population growth and human needs in recent years. Therefore, control of vehicles is becoming a big problem in every country and is much more difficult to solve. Sometimes it becomes difficult to identify vehicle owner who violates traffic rules and drives too fast. Therefore, it is not possible to catch and punish those kinds of people because the traffic personal might not be able to retrieve vehicle number from the moving vehicle because of the speed of the vehicle. Therefore, there is a need to develop Vehicle Number Plate Recognition system (VNPR) to deal with this problem. There are numerous VNPR systems available today. These systems are utilized frequently for access control in buildings and parking areas, law enforcement, stolen car detection, traffic control, automatic toll collection and marketing research. These systems are based on different methodologies but still perfect recognition remains a challenging task because some of the factors like high speed of vehicles, non-uniform vehicle number plates, language of vehicle number and different lighting conditions. Most of the systems work under these limitations.

Vehicle Number Plate Recognition (VNPR) system is a combination of image processing, character segmentation and recognition technologies used to identify vehicles by their license plates. Vehicle Number Plate Recognition is a part of a more general research area called Text Information Extraction (TIE) .TIE algorithms are used to extract textual information from video streams and images. In the VNPR problem, the textual information is the license plate characters. Similar to other TIE applications, number plate recognition involves four phases; image acquisition, localization, segmentation, and recognition of characters in a given image. However, unlike applications like document recognition, VNPR systems generally operate on noisy and low quality images, in which illumination conditions may frequently cause difficulties. VNPR applications apply image processing and segmentation algorithms for license plate extraction, and each operation involves lots of computation. Implementing the algorithms for each of these four

phases is a challenging task due to such difficulties.

In the image acquisition phase, the image is captured for processing to extract the license plate characters. There is a possibility of improper orientation of the installed camera due to technical or environmental factors. In such cases, the captured images are skewed and needs to be aligned in proper position. A very limited VNPR systems deal with such scenario and those are also restricted in certain conditions. The methodology to deal with such problem is proposed.

Localization of the license plate from a large scene is a challenging task due to the presence of noise. This is second phase of VNPR process. The existing approaches work under certain constraints and hence do not give good performance on every condition. Further, when car is in the motion, the image captured becomes blurred. A methodology to deal with all such factors is proposed in this work.

Segmentation is performed after localization to extract the characters in the license plate for further recognition. The segmentation process needs to consider the varying conditions of font size, color, brightness, etc. Further existing approaches assume that the plate orientation is correct i.e. it is aligned with the horizontal axis of the car. In such cases there is a need to deal with the skewness of the text image. A methodology is proposed to perform segmentation that is capable to give the satisfactory performance under such varying conditions.

Finally the text is read for license plate recognition. There is a possibility that installed camera is not of good quality and hence the text image is not very clear and visible due to its small size. Moreover, the characters differ in font, size, contour, etc. A robust technique to extract the features of the characters, based on vector contour is proposed to deal with such limitations.

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Hitesh Rajput

Contents

List of Figures

List of Tables

List of Abbreviations

ANN	Artificial Neural Network(s)
CCTV	Closed-circuit Television
FT	Fourier Transform
HDR	High dynamic range
HOG	Histogram of Oriented Gradient
IFT	Inverse Fourier Transform
MCS	Monte Carlo simulation
MLF	Multi-layer feed-forward
MSER	Maximally stable external regions
OCR	Optical Character Recognition
PCA	Principal Component Analysis
RT	Radon Transform
SIFT	Scale-Invariant Feature Transform
STFT	Short Time Fourier Transform
SVM	Support Vector Machine
VC	Vector Contour
VE	Vector Element
VNPR	Vehicle Number Plate Recognition (System)
WT	Wavelet Transform

List of Symbols

$f(x,y)\tilde{*}m[x,y]$	A periodical convolution of the function f with m
v_m	maximum value of the projection
$P(X)$	Joint probability
$K(x_i,x_j)$	kernel function
ω	frequency
$X(\omega)$	fourier transform of X_i
$STFTx(t))$	Short Time FT of signal x(t)
σ_t^2	temporal variance (of wave function)
σ_ω^2	frequency variance (of wave function)
$\|\|f\|\|$	norm of the function f
$Wx(u,s)$	Wavelet transform of function x
$p(\phi,\xi)$	Radon transform of p
A_{GL}	RGB colored image
A_R	Red spectrum of the color image
A_G	Green spectrum of the color image
A_B	Blue spectrum of the color image
$\hat{X}$	Estimated value of X
ϵ_k	Euclidean distance
$f_{ST}(x,t)$	spatiotemporally-filtered distance at x and time step t
$\mathcal{R}\{\mathcal{G}[g]\}(b,\hat{\boldsymbol{\xi}})$	RT of the line segment indicator function of segment $\boldsymbol{g}$
$\mathcal{R}\{\mathcal{B}[\boldsymbol{s}]\}(b,\hat{\boldsymbol{\xi}})$	RT of the strip indicator function of strip $\boldsymbol{s}$
$\mathcal{R}\{\mathcal{P}[\boldsymbol{s}]\}(b,\hat{\boldsymbol{\xi}})$	RT of the pixel indicator function of pixel $\boldsymbol{p_0}$