International Journal of Computer Applications (0975 – 8887)
International Conference on Computing and information Technology (IC2IT-2013)

Indian Licence Plate Recognition System in IR-Image Character Segmentation using Smearing Method

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ABSTRACT

In this paper, a smart and simple algorithm is presented for Indian vehicle's license plate recognition system This introductory paper describes the need of Indian license plate detection, recognition system, Indian license plate characters, Structure of Indian License plates, and License Plate image pre-processing methodologies. For extracting the license plate methods and such as to detect region - edge detection algorithms segmentation part-smearing methods, filtering and some morphological are used. At the end statistical based template matching is used in the part and of plate characters for page blocks Segmentation; other proposed techniques which are based on either a top-down or bottom-up approach. This thesis mainly concentrates on the part of IR-Image Character Segmentations. The performance of the proposed algorithm has been tested on several real time images and based on the experimental results; our algorithm is robust and shows superior results over the existing algorithms.

Keywords

License Plate Recognition (LPR), Intelligent Transportation Systems (ITS), Near Infrared (NIR), Shortwave Infrared (SWIR), Forward-Looking Infrared (FLIR.).

1. INTRODUCTION

This work is on the research and development in the area of Indian License Plate Recognition; problems associated with recognition of license plates of varying structure and size; frames and formulates a workable solution for implementing Indian license plate recognition systems in various dynamic conditions using Localization and Correlation based recognition algorithms. The Major contributions of the work are that the Indian License Plate Detection and Recognition in various Smearing algorithms for Font information includes character point size, word spacing, character leading, ascenders, descenders, baseline, and middle line. Character point size is equivalent to a character height. This thesis mainly concentrates on IR-Image Character Segmentation Using Smearing Method.[7]

1.1 Need for License Plate Recognition

License Plate Recognition (LPR) is a form of automatic vehicle identification by using advanced image processing technology like computer vision and machine learning. It is an important stage in all Intelligent Transportation Systems (ITS) applications like Electronic Toll Systems, Lane Departure Warning System, and Intelligent Traffic Control System etc. The proposed algorithm consists of three major stages: License Plate Localization, Segmentation of Characters and Recognition of segmented characters.

The goal of localization is to eliminate all the background and preserve only the number plate area from the input IR-Image. Here, the vehicles are identified only by their license plates and no external cards, tags and sensors or transmitters are used. For implementing Indian license plate recognition systems in various dynamic conditions shown the following Fig.1.1. Research Frame Work.[7][8][9].

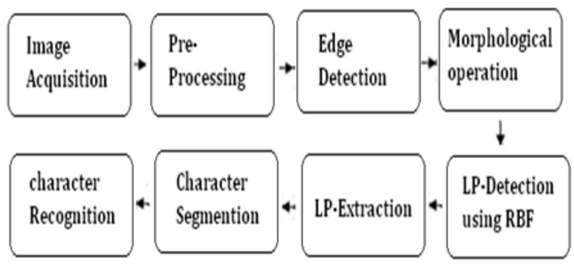


Fig.1.1. Research Frame Work

2. CHARACTER SEGMENTATIONS

[7][8]Character segmentation is the procedure of extracting the characters and numbers from the license plate image. Diverse aspects make the character segmentation task complicated, like IR-Image noise, plate frame, space mark, plate's rotation and light variance. A numbers of procedures have been proposed for character segmentation to overcome these problems. The approach used in this work for character segmentation is based on thresholding and Connected Component Analysis (CCA).In binary image processing, CCA is an important technique that scans and labels the pixels of a binarized image into components based on pixel connectivity. Each pixel is labeled with a value depending on the component to which it was assigned. Conditions like high/low luminance, Rainy The page orientation can be in either portrait mode (horizontal printing) or landscape mode (vertical printing). The connected components are then analyzed to filter out long and wide components and only left the components according to the defined values. Finally, height to width ratio is used to separate the English numbers from Indian word. its related word is treated as a single word and does not separated into individual letters, because it is written on every LP of India. On the extracted LP from the previous phase, following are the steps that would be performed for character segmentation in this phase. The Connected Component Analysis was used for character segmentation while the recognition process was based on selected extracted features.[7]

2.1 Indian Vehicles License Plate Registration

As this research work is based on the Indian License plates, the information to follow are of vital importance and necessary for all considerations. All motorized road vehicles are tagged with a license number in India. The license plates are placed in the front and back of the vehicle.

The President of India and state governors travel in official cars without license plates. Instead they have the Emblem of India in gold embossed on a red plate. Since June 1, 2005, the Government of India has introduced High Security Registration (HSR) number plates which are tamper proof.

2.2 Introduction and Background

Automatic Vehicle Identification (AVI) has many applications in traffic systems (highway electronic toll collection, red light violation enforcement, border and customs checkpoints, etc.). License Plate Recognition is an effective form of AVI systems. The proposed algorithm consists of three major parts: Extraction of plate region, segmentation of characters and recognition of plate characters. For extracting the plate region, edge detection algorithms and smearing algorithms are used. In segmentation part, smearing algorithms, filtering and some morphological algorithms are used. And finally statistical based template matching is used for recognition of plate characters.

3. BASIC FEATURES

A horizontal/vertical projection histogram is the sum of black pixels projected onto the vertical/horizontal axis. A crossing count histogram represents the number of times that pixels in a row/column turn from 0 to 1. A textual square is defined as an area in which text data is dominant. A non-textual square is an area in which blank or non-textual data is dominant. A textual row/column is a row/column in which textual data is dominant while a blank row/column consists of majority of white pixels. A bottom line of non-descended characters is called the baseline. While a top line of non-ascender characters is the middle line[4][5][11].

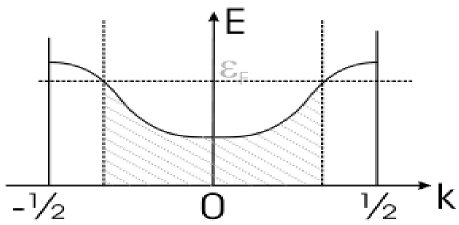
3.1 Smearing Methods

Problem: in metallic systems Brillouin-zone integrals over functions that are discontinuous at the Fermi-level. (1) High Fourier-components,(2)Dense grid is necessary. Solution: replace step function by a smoother function. Example: band structure energy.[11]

$$\sum_{n\mathbf{k}} \omega_{\mathbf{k}} \varepsilon_{n\mathbf{k}} \bar{\Theta}(\varepsilon_{n\mathbf{k}} - \mu)$$

$$\text{with:} \bar{\Theta}(x) = \begin{cases} 1 & x \leq 0 \\ 0 & x > 0 \end{cases}$$

$$\Rightarrow \sum_{n\mathbf{k}} \omega_{\mathbf{k}} \varepsilon_{n\mathbf{k}} f\left(\frac{\varepsilon_{n\mathbf{k}} - \mu}{\sigma}\right)$$



3.2 Page Borders Determination and Removal

[4][5]This step readjusts page borders to minimize the existence of any gutter borders or any border remnants within an image content area (the desired area of the page containing information). By segmenting objects around edges of the content area and checking their distances against IR-Image edges, gutter borders and border remnants are located and removed. The following procedure describes step-by-step how to determine page borders:

(1) Smear horizontally with constraint Wx (for portrait image) or Wy (for landscape IR-Image) and smear vertically with constraint Wy (for portrait image) or Wx (for landscape image),

(2) For the top and bottom edge areas of the image content, perform objects' segmentation, calculate objects' coordinates, and discard any objects whose sizes are less than or equal to MinFONTSIZE.[4][5].

(3) Adjust the top/bottom border by (a) locating objects that are not connected to the top/bottom border and (b) setting the new top/bottom border as the minimum/maximum top/bottom row among these objects and as the new IR-Image content area.

(4) For the left and right edge areas of the new IR-Image content, perform objects' segmentation, calculate objects' coordinates, and discard any objects whose sizes are not greater than MinFONTSIZE.[4][5][6][11].

(5) Adjust the left/right border by a) identifying objects that are not connected to the left/right border, the new top border, and the new bottom border and b) setting the new left/right border as the minimum/maximum left/right column among these objects.

(6) Remove page borders of an IR-Image using the new borders. Page blocks segmentation process The page blocks segmentation process segments binary document IR-Images into blocks using an adaptive smearing algorithm in which any decisions on merging and/or separating are based on the estimated font information of binary document IR-Images. Font information and page orientation are used to derive the constraints for the smearing algorithm. The page blocks segmentation process is an adaptive bottom-up approach and it consists of three steps and each step will be discussed in detail in the following subsections[11].

3.3 Plate Region Extraction:

Plate region extraction is the first stage in this algorithm. IR-Image captured from the camera is first converted to the binary IR-Image consisting of only 1’s and 0’s (only black and white) by thresholding the pixel values of 0 (black) for all pixels in the input IR-Image with luminance less than threshold value and 1 (white) for all other pixels[4][5][6].

3.4 Smearing Constraints Calculation

The word spacing depend on the character height and the recommended normal word spacing value is one-third of the character height. The horizontal and vertical smearing distances Sx and Sy, respectively, should be selected to minimize the following two conditions: (1) words belonging to different columns are not connected and (2) words belonging to different rows are not connected. For a portrait IR-Image, Sx is chosen to be the normal word spacing, while Sy is three-quarters of the character leading. For a landscape document IR- Image, the chosen values of smearing distances are reversed.[11]

3.5 Horizontal and Vertical Smearing

A binary document IR-Image can be segmented into blocks using the smearing algorithm. IR-Images are segmented by sequentially smearing in both horizontal and vertical directions using smearing distances Sx and Sy selected previously. [4][5][6]

(1) For a portrait IR-Image, smear horizontally with Sx and then smear vertically with Sy to produce the segmented IR-Image. (2) For a landscape image, smear vertically with Sy and then smear horizontally with Sx to produce the segmented image. The segmented binary image obtained by applying the smearing algorithm with constraints Sx ~ 9 pixels and Sy ~ 4 pixels to the image [4][5][11].

4. SEGMENTATION

In the segmentation of plate characters, license plate is segmented into its constituent parts obtaining the characters individually. Firstly, IR-Image is filtered for enhancing the IR-Image and removing the noises and unwanted spots. Then dilation operation is applied to the IR-Image for separating the characters from each other if the characters are close to each other. After this operation, horizontal and vertical smearing are applied for finding the character regions. Night vision technologies can be broadly divided into three main categories:

4.1 IR-Image Intensification

IR-Image intensification technologies work on the principle of magnifying the amount of received photons from various natural sources such as starlight or moonlight.[5] Examples of such technologies include night glasses and low light cameras[3][5].

4.2 Active Illumination

[3][4][5]Active illumination technologies work on the principle of coupling imaging intensification technology with an active source of illumination in the near infrared (NIR) or shortwave infrared (SWIR) band. Examples of such technologies include low light cameras [5].

4.3 Thermal Imaging

[3][4][5]Thermal imaging technologies work by detecting the temperature difference between the background and the foreground objects. Some organisms are able to sense a crude thermal image by means of special organs that function as bolometer.[4]

4.4 Imaging Results With (Top) And Without (Bottom) Active-Infrared.

[3][4][5]Active infrared night vision combines infrared illumination of spectral range 700–1,000 nm (just below the visible spectrum of the human eye) with CCD cameras sensitive to this light.

The resulting scene, which is apparently dark to a human observer, appears as a monochrome IR-Image on a normal display device. Because active infrared night vision systems can incorporate illuminators that produce high levels of infrared light, the resulting images are typically higher resolution than other night vision technologies. Active infrared night vision is now commonly found in commercial, residential and government security applications, where it enables effective night time imaging under low light conditions [3][4][5][6].

4.5 Laser Range Gated Imaging

[4][5]Laser range gated imaging is another form of active night vision which utilizes a high powered pulsed light source for illumination and imaging. [5]One of the key advantages of this technique is the ability to perform target recognition as opposed to detection with thermal imaging.

4.6 Thermal Vision

[3][5]Thermo graphic camera and infrared. Thermal imaging cameras are excellent tools for night vision. They detect thermal radiation and do not need a source of illumination.

They produce an IR-Image in the darkest of nights and can see through light fog, rain and smoke. Thermal imaging cameras are widely used to complement new or existing security networks, and for night vision on aircraft, where they are commonly referred to as "FLIR" (for "forward-looking infrared".) Functions by detection of thermal radiation [3][5][6].

4.7 Image Intensifier

This is much like a CRT television, but instead of color guns the photocathode does the emitting. The image is said to become "intensified" because the output visible light is brighter than the incoming IR light, and this effect directly relates to the difference in passive and active night vision goggles. Currently, the most popular IR-Image intensifier is the drop-in ANVIS module, though many other models and sizes are available at the market[5][6].

4.8 Night Vision Devices

[4][5][6]A Night Vision Device (NVD) is a device comprising an IR-Image intensifier tube in a rigidcasing, commonly used by military forces. Lately, night vision technology has become more widely available for civilian use. For example, enhanced vision systems (EVS) have become available for aircraft to help pilots with situational awareness and avoid accidents.

[5].These systems are included in the latest avionics packages from manufacturers such as Cirrus and Cessna.

5. INFRARED IMAGES

[4][5]The formation of a visual IR-Image of an object by means of the object's own thermal (infrared) radiation or the thermal radiation reflected from the object. Infrared imaging is used to determine the location and shape of objects in darkness or in optically opaque media and to study the degree of heating of individual sections of complex surfaces and the internal structure of bodies that are opaque in visible light. Radiation in the infrared region of the electromagnetic spectrum is characteristic of bodies. with temperatures of several tens of degrees Celsius. Infrared radiation is invisible to the human eye, but it can be detected by various thermal radiation detectors (RADIATION DETECTOR) and converted to a visual image by several methods.[3][4][5][6].

[4]The first infrared imaging systems were built in the late 1930's and found some applications during World War II in detecting military and industrial objects; these systems used heat sensors—bolo meters and thermocouples—that converted infrared radiation into electrical signals. By means of an opto mechanical scanning system, discrete points on the object were successively projected to the sensor, and the electrical signals obtained from the sensor were fed to the input of a cathode-ray tube that was similar to a television picture tube; a visual image of the object was formed on the luminescent screen of the tube.Liquid crystals, crystal phosphors, thin films of semiconductors, magnetic thin films, and heat-sensitive lacquers and paints can be used as temperature sensitive substances.

[3][4][5][6]The use of phosphors in infrared imaging is based on the phenomenon of the quenching of luminescence: the brightness of the luminescence of certain phosphors excited by ultraviolet radiation diminishes sharply as the phosphors are heated. Such phosphors make it possible to observe temperature changes of 0.2°–0.3°C visually, and the quenching effect is completely reversible. Instruments that make use of phosphors permit imaging from radio waves as well as infrared waves [3][5][6].

5.1 Advantages In IR-Images

That imagery produced as a result of sensing electromagnetic radiations emitted or reflected from a given target surface in the infrared position of the electromagnetic spectrum (approximately 0.72 to 1,000 microns).This category concerns technology for, and applications of, Infrared Imaging, also known as thermal imaging or thermograph[5][6].

6. DILATION

[3]Dilation (Dilate, Grow, Expand) is one of the two basic operators in the area of mathematical morphology, the other being erosion. It is typically applied to binary images, but there are versions that work on grayscale images. The basic effect of the operator on a binary image is to gradually enlarge the boundaries of regions of foreground pixels [1][4][5][6].

6.1 Binary Images

[2]Binary images are images whose pixels have only two possible intensity values. They are normally displayed as black and white. Numerically, the two values are often 0 for black, and either 1 or 255 for white. Some morphological operators assume a certain polarity of the binary input image so that if we process an image with inverse polarity the operator will have the opposite effect [2][3][4][6].

6.2 Grayscale Images

[3]A grayscale (or gray level) image is simply one in which the only colors are shades of gray. In fact a `gray' color is one in which the red, green and blue components all have equal intensity in RGB space, and so it is only necessary to specify a single intensity value for each pixel, as opposed to the three intensities needed to specify each pixel in a full color image. The grayscale intensity is stored as an 8-bit integer giving 256 possible different shades of gray from black to white [2][4][5][6].

7. EXPERIMENTAL RESULT

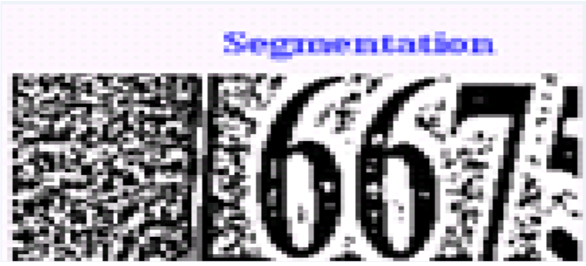
All 497 binary images used in this experiment are 8.5 x 11 inches and were scanned at 200 dpi resolution. These images were selected from several different medical journals and represent a wide range of font sizes. For all of these images, the estimated font sizes are within ±2 pixels of their actual sizes.

For the page borders algorithm, all textual and non-textual borders existing in 495 images are removed, including gutter borders. Its algorithm for successfully cleaned up page borders at an accuracy rate of 99.6%.

For the page blocks segmentation algorithm, all images were correctly segmented into blocks.

For images having more than one font type, words of smaller font in different rows sometimes are joined together.

INDIAN LICENCE PLATE RECOGNITION SYSTEM IN IR-IMAGE SEGMENTATION



Example Indian Licence Plate

SEGMENTATION LOADING THE CHARACTER AND DIGITS

TN03E6675 TN07AB1177 TN72AF67 77

8. FUTURE ENHANCEMENT

In this paper, two algorithms have been presented to enhance the infrared (IR) images. Two such algorithms have been developed and implemented in this paper. Theoretical and algorithmic results show remarkable enhancement in the acquired images. This will help in enhancing the visual quality of IR images for surveillance applications [5][6].These works implement on the work Skew and Slant Corrections for IR images.

9. CONCLUSION

I have presented algorithms for detecting the page borders of binary document IR-Images and for segmenting binary document IR-Images into blocks. As a result, for this algorithms are able to handle effectively a wide variety of document IR- images having different font sizes. The performance of the proposed algorithm has been tested on several real time IR-Images and based on the experimental results; this algorithm gives that the robust and shows superior results over the existing algorithms**.**

10. ACKNOWLEDGMENT

The authors would like to thank the anonymous reviewers for their comments that helped to improve the presentation of the paper.

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