



## A Survey of Image Processing Techniques and Wavelets used in Automatic Number Plate Recognition System

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**Abstract**— ANPR is one of the important research subjects in the intelligent transport system. The ANPR provide the information about vehicle and its owner. Vehicle are increase rapidly so crimes, stealing problem Increase. ANPR system plays an important part in intelligent transport system(ITS) such as detection of stolen vehicle, traffic management, automatic payment of tolls plaza on highways, parking lots access control system etc. So, now a day’s automatic number plate recognition system developed for analysing and controlling the moving vehicles in cities and roads. In this paper we study the ANPR system, its phases and technology. We also study the different wavelet function and its applications, these wavelets are used for image recognition, segmentation and processing. In last phase we conclude comparison analysis between haarwavelet, template matching and daubechies wavelet.

**Keywords**— ANPR, Acquisition, Character Segmentation, Localization, DWT, Haar wavelet.

### I. INTRODUCTION

History of ANPR system started in 1976 when the Police Scientific Development Branch organized in the UK [8]. It is one kind of an Intelligent Transport System [11] and it is significant interest because of its prospective applications in highway electronic toll collection and traffic monitoring systems. Due to rapid development of vehicle [15] on road and highway, human are facing numerous problem like stolen, accidents, criminal use vehicle and invalid number plate so due to these problem need traffic management [8]. Automatic number plate system is important techniques facing these types of problems. The Automatic Number Plate Recognition [ANPR] Systems occurs for a long time, but only in the late 90s it became an important application because of the rapid growth in the number of vehicles. The ANPR is a image processing techniques [3], to read character from image and identify number using various algorithms and techniques. Image exemptions[18] is the process of image convert original image into alphanumeric image using accurate operation on signal processing and extract information about image. Automatic number plate understand by a computer system, that utilize automatically [9] number plate recognition for data input automation.

In the initial days template matching [3] was used as a operator for recognition of number plate but its sensitive and noisy [6], so now a day’s used neural network and fuzzy logic for recognition number plate. Some other method is also used for image recognition which are described in section 2. Digital camera is basic input device to capturing image. The captured image is automatically recognize the number plate of vehicle using ANPR system, which is matched to the central database and find the information about number plate’s vehicle and its owner.

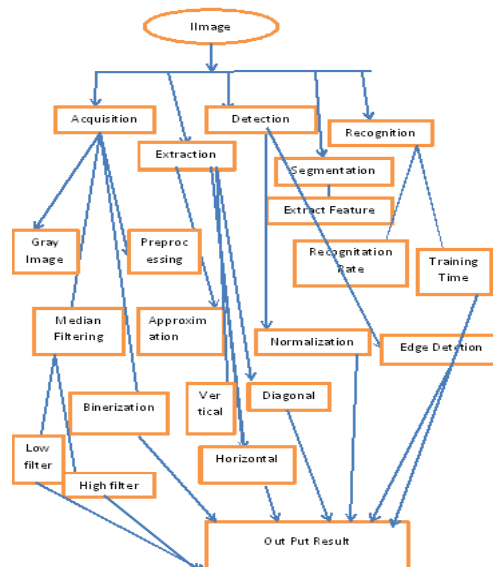


Figure 1 Image Processing Flow Chart

In the pre-processing phase convert the original image into grayscale and reduce the noise of image apply two types of filter (low pass filter and high pass filter), after that convert it into binary image and remove the noise from image and finally binary image used for input image to extract feature from it. This process is done by various technique and phases define in next section.

### A. Phases of ANPR System

Automatic number plate recognition is a process to read character from image and identify the number in given image. For number plate recognition before applying any algorithm on image some pre-processing is done on the captured image, ANPR [12] system is described in next section in which implement process, it follows following phases for vehicle plate identification [14].

Phases of ANPR system:

- Image Processing
- Extraction phase
- Detection phase
- Segmentation phase
- Recognition phase

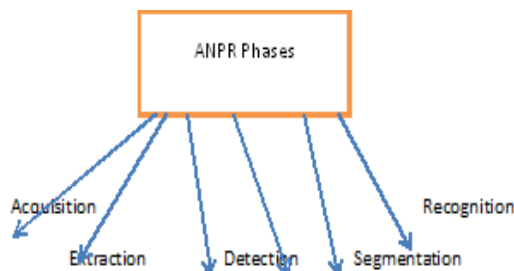


Fig.2 ANPR Phases

- **Image Acquisition:** - Image acquisition is the initial step of ANPR system [12]. In this phase image is acquired using a high perseverance digital camera having inbuilt function and some preprocessing operation such as input image convert to gray color, filter the image for reduce noise after that apply the binarization techniques on image for make better quality of image.
- **Number Plate Extraction [12] :-** After the acquisition extract section [4] of image using various techniques such as detection, segmentation etc., find out location of image, in the extract phase decompose the image into four separate parts (Approximation, horizontal, vertical, diagonal) and extract position of image and find out details about image.
- **Number Plate Detection:-** After decomposition detect the character from number plate, detection determine the speed and accuracy of image, in the detection phase used normalization algorithm [11] and using edge detection calculate edge component value and detect the character.
- **Character Segmentation [12]:-** Detected number segmented into individual words and analysis the position of image. In the segmentation used connected component based method to find the assets of character. Character Segmentation separates each letter or number where it is consequently processed by optical character recognition (OCR) algorithms.
- **Optical Character Recognition:-** OCR [12] is the last phase of ANPR system. In this phase spot the eccentric and identify the vehicle number, deciphering the captured image into an alpha numeric text entry [10]. The classification is based on the mined geographies. These features are then classified using either the statistical, syntactic or neural approaches.

### B. Elements of ANPR System

ANPR system [8] consists of following elements:-

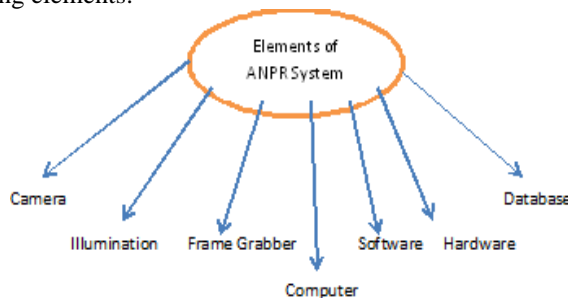


Fig .3 Elements of ANPR system

- **Digital Camera:-** It is used for capture image of a vehicle from either front or rear end, captured image and feed into ANPR system in neural network.

- **Illumination [9]:**-It is used for controlled light that can bright up the plate number.
- **Frame Grabber:**-Its work as a interface between digital camera [6] and ANPR system. It is cohesive with procurement and motion control.
- **Computer:** -Computer is a system in which ANPR procedure install and fed image from digital camera, convert image to gray color, analyze and perform various operation on image.
- **Software:**-The ANPR system is a OCR software [12] that is used to read the text from scanned document. Digital camera capture the image of number plate from back end or front end and fed input into ANPT software then software extract detail of number plate.
- **Database:**-It is the collection of information. ANPR system software include database , after fed image into system check record into central database and identify vehicle number owner and other information related to his

### C. Application of ANPR System

- Detecting Vehicle in black list
- Traffic control
- Red Light Control
- Automatic Toll Gates Border Crossing
- Homeland Security
- Access Control
- Motorway Road Tolling
- Journey Time Measurement
- Law Enforcement

## II. EXISTING TECHNOLOGY OF NUMBER PLATERECOGNITION

The algorithms are quite thorough and classic that require hundreds of thousands lines of software code for compensation of complexity [13]. Algorithm is the step by step solution for any problem using coding, for large number of complexity use mathematical model for constructing solution. There are six algorithms successfully used for complexity solution.

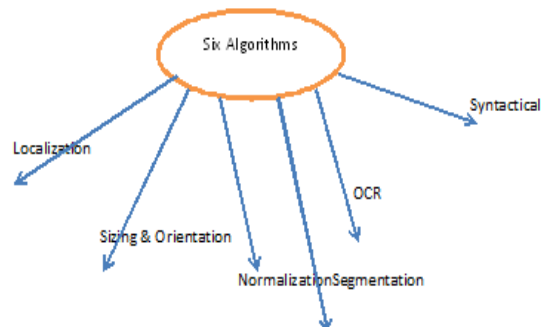


Fig 4 Existing Techniques

- **Localization :-**In the localization[1][5] techniques find out the position of image of vehicle number plate and identify the number plate and recognize the complexity for algorithms what area of vehicle not contain number plate. Algorithms apply geometrical operation on vehicle and find out position of number plate, and find characteristics of number plate the algorithm pursuits for a similar background color of unified fraction and contrast as a means to segregate objects on a vehicle.
- **Number Plate Sizing and Orientation Procedure [1]:**-In this procedure used to gaunt slope for calculate the size of component of image of number plate.
- **Normalization Technique [1]:**-In this technique t regulating the contrast and brightness of the captured number plate image.

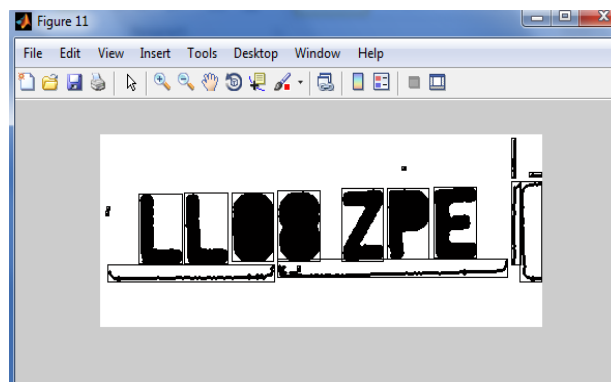


Fig 5 Character Segmentation

- **Character Segmentation Algorithm**:-In this algorithms separate each alphanumeric character which has having each separate boundary box which is shown in fig 1.4
- **Syntactical**:-Algorithm confirm alpha numeric information of character form number plate and after confirmation arrange in a specific order and apply operation for execution.

### III. WAVELETS USED FOR NUMBER PLATE IDENTIFICATION

Wavelets [8] and neural network are used for number plate recognition system; number plate recognition used various types of wavelets. These wavelet are classified on the basis of their properties [9]. Major classification is based on the signal whether it is continuous or discrete. Discrete wavelets more widespread due to their relations to multi-resolution filter banks. These wavelets have Finite Impulse Response [19]. Orthogonal wavelets decompose signals into orthogonal signal spaces. All orthogonal wavelets are asymmetric, but haar wavelet is orthogonal but symmetric. Some of wavelets are describe in this section.

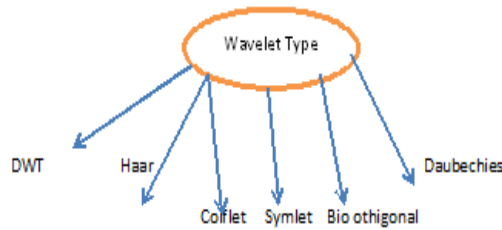


Fig 6 Wavelets

#### A. Discrete Wavelet Transform:-

DWT wavelet [5] is representfunction involves quantity of signal. It is defined as a set of non linear cores utility, which isdivided into thenon linear quantity of sub bands. It provide appropriate information for analysis and amalgamation for original image .It decompose the signal into four components i.e. approximation, horizontal, vertical, diagonal. DWT used two types of function first one is scale function and formally is wavelet function .This function associated with median filter for resolution of signal, and used into low pass and high pass filter[2] and both are depend on each other.

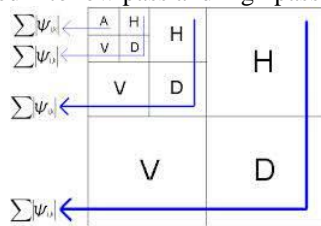


Fig. 7 Wavelet Decomposition Levels

#### A (i). Advantages of Discrete Wavelet Transform

- Advantages on fourier analysis, temporal resolution.
- Orthogonality and scalability.
- Efficient multi-resolution.
- Assists progressive transmission.
- Improves the block artifacts.

#### B. Haar Wavelet:-

Haar wavelet is the orthogonal wavelet [7] that has symmetric examination and separation filters. Haar wavelet is known as haar transform, for the mathematical operation. It has two version 1D and 2D. 1D haar wavelet is used for find average value of image pixel and detail of signal and 2D haar wavelet [5]decompose image into orthogonal sub bands with LL, LH,HL,HH parallels[5] to approximation, horizontal, vertical, diagonal. It detect [20], feature abstraction and characteristic of number plate recognition system. Haarwavelet reduces the noise from signal so it is better technique as compare to template matching technique. Haar wavelet takes less time for character exposure, eccentric segmentation, feature extraction and for training.

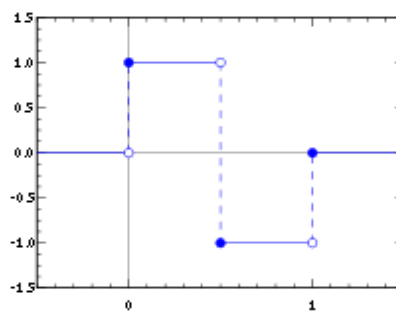


Fig 8haar wavelet

**B (i) Properties of Haarwavelet[8]**

- Orthogonal form and symmetric.
- Sudden transition.
- Support linear combination for continuous real function
- Not need multiplication, need only addition
- Input, output length are same
- Computation time is short.

**C. Daubechies Wavelets:-**

The Daubechieswavelets are also orthogonal asymmetric waveletsfunction. It is used for defining a discrete wavelet transform and characterized by a maximal number of vanishing moments for some given support. It supports a scaling function which generates an orthogonal multi-resolution analysis. D2-D20 Daubenchies wavelets are follow a recurrence relation which is used for text feature . When any operation applies on image it overlap the window and reflect all changing pixel intensity on work space. It has eight taps and more than two vanishing moment and coefficient filter.

**D. Symlet Wavelets:-**

The symlets are symmetrical wavelets projected by Daubenchies as modifications to wavelet family.

**E. Coiflet Wavelets:-**

Coiflet wavelet derived from Daubenchies wavelets. Coifletwavelet more overlaps on window and having high computation power. It is discrete wavelets which have scrambling functions with evaporation moments. It uses more than two vanishing moment for filter the image.

**F. Application of Wavelet Transform [8]**

- Data and image compression
- Audio Applications.
- Signal Processing
- Control Applications
- Partial differential equation solving.
- Pattern Recognition.
- Computer Graphics
- Numerical analysis.
- Texture analysis.
- Noise Reduction.

**IV. ANALYSIS**

**Comparison between haarwavelet, Template Matching and Daubechies Wavelets.**

| <b>HaarWavelet</b>  | <b>Template matching</b>                               | <b>Daubechies Wavelets</b>                             |
|---|--|--|
| It is simplest wavelet, it has only 2 taps                        | It is sensitive to noise and has 8 taps                | It is family oh orthogonal and has 8 taps              |
| It used 2 coefficient for median filter                           | It used more than 2 coefficient for median filtering   | It used more than 2 coefficient for median filtering   |
| It has one vanishing moment and one linear phase for segmentation | It has more than one vanishing moment                  | It has more than one vanishing moment                  |
| It is symmetric wavelet   | It is asymmetric wavelet                               | It is asymmetric wavelet                               |
| It takes less time for training                                   | It takes more training time as compare to haar wavelet | It takes more training time as compare to haar wavelet |
| Haar Wavelet does not have overlapping on window                  | It has overlapping on window                           | It has overlapping on window                           |
| Do the changing only adjacent pair of pixel                       | Changing all pixel and intensity                       | Changing all pixel and intensity                       |

**V. CONCLUSION**

In this paper we review ANPR system existing research paper and find out that various technology and method used for number plate identification, After analysis the various techniques concluded that haar wavelet used with neural network is better techniques for number plate recognition, it takes least time for computation.

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