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# Number Plate Detection of Moving Vehicle by Image Processing

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**Abstract:** Given the advancement of technology into the new age of electronic and communication, it is no wonder we would expect ourselves to use Digital Image Processing to capture and transform data images within the shortest and most accurate period of time. In this project, MATLAB software – Image Processing Toolbox will be adopted for the development of algorithms for image processing on a moving base vehicle. The task will be studied based on several data abstraction levels: image restoration, image segmentation and two-dimensional object recognition. Generally, the first approach will be applied for noisy and degraded images whereas the second approach will be applied for low and segmentation-level analysis of infinite image sequences. The last approach is suitable for two-dimension tracking.

**Keywords:** Image restoration, Restoration Methodology, median filter, Image Segmentation, Representation.

## I. INTRODUCTION

The number of vehicles is increasing globally and traffic congestion has emerged to be a main concern for public and transportation engineers. The optimal use of existing transportation facilities has become a major priority in congested urban areas. Many countries have implemented different types of toll system for toll charges along highways, bridges and tunnels that is best suited for the situation. With the advancement of technology, Toll System can be implemented with the integration of Digital Image Processing for vehicle classification to implement toll charges. The operation requires image acquisition, pre-processing and several processing operations to improve the image information for human interpretation and autonomous machine perception [1].

Xiouyin et al. [2] have presented an adaptive two-pass Median filter to remove impulsive noise. An image contaminated by impulsive noise is represented in a two-pass Median filtering and is processed by a Median filter twice. By analyzing the spatial distribution, i.e., the error index matrix of the impulsive noise, the adaptive two-pass Median filter looks for columns containing over-corrected pixels by the standard Median filter and replaces over-corrected pixels by their original values. The experiment that has been done shows that the adaptive filter is able to reduce the mean square (MSE) and mean absolute error (MAE) produced better results.

Yanchun et al. [7] proposed an algorithm for image denoising based on Average filter with maximization and minimization for the smoothness of the region, unidirectional Median filter for edge region and Median filter for the indefinite region. It was discovered that when the image is corrupted by both Gaussian and impulse noises, neither Average filter nor Median filter algorithm will obtain a result good enough to filter the noises because of their algorithm. The image is divided into different regions using neighborhood contrast intensity and employ different methods to denoise the pixels in different regions. This is not only to maintain the characteristic that the Average filter algorithm has a better denoising effect on Gaussian noise, but take into account that Median filter algorithm can better preserve the details. Experiments that been done show that the proposed algorithm is practicable and competent.

Wiener filters are extensively used for inverse problems. Wiener filter provides the best restored signal with respect to the square error averaged over the original signal and the noise among linear operators [8]. Based on Wiener filter method, F. Jin et al. [4] considered the adaptive Wiener filtering of noisy images and image.

## II. IMAGE RESTORATION

Image restoration can be done with applying different types of filter to clean up noisy and degraded images. However the result may not be good and varies based on the capability and limitation of each filter. Several types of filter methodology will be analyzed. The objective of restoration techniques concern the removal or reduction of degradations that have occurred during image acquisition and improved the image in some predefined sense. Restoration techniques tend to be based on mathematical or probabilistic models of image degradation. Degradations include noise, which are errors in pixel values, or blurring images due to camera motion. The approach to image restoration includes identification and noise-modeling problems. Noise can be defined to be any degradation of the image signal caused by external disturbance during image acquisition [1].

## III. IMAGE SEGMENTATION

Image segmentation is the identification and isolation of an image into regions that correspond to structural units the approaches to segmentation is categorized into three

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classes of techniques: Pixel-based methods and edge-based methods and region-based methods. Pixel-based techniques are. the easiest and least powerful due to the operation on one element and are susceptible to noise interference. Region based and edge-based are considered as dual techniques: Region-based approach focuses on the continuity searches for similarities while the latter focuses on discontinuity searches for differences. The considered techniques will be investigated for their capabilities [2].

## IV. IMAGE REPRESENTATION

The process of image representation begins with segmenting and representing the aggregate of segmented, 'raw' pixels in a form suitable for further processing. Representation of the region of an image involves two methods: represent the region based on boundary, or the pixels comprising the region. Representation has led to nearer to precise classification of the image. Chain codes, also termed as freeman chain codes, are used to represent a boundary by connection sequence of straight-line segments with specific length and direction [2].

## V. FILTERING TECHNIQUES

Filtering techniques can be broadly categorized into two types, i.e., Linear Diffusion Filtering and Non-Linear Diffusion Filtering. Linear Diffusion filtering can remove the noise efficiently and at the same time can eliminate the semantically useful information. Different from Linear Diffusion Filtering, Non-Linear Diffusion Filtering can reduce the noise while preserving (or even enhancing) important features of the image such as edges. In this case, the Non- Linear Diffusion Filtering can be used for the reduction of the speckle noise in the ultrasound image such as median filter, average filter and wiener filter. Each filtering technique has its own advantages and disadvantages [1].

i) ADAPTIVE MEDIAN FILTER:-
The median filter is a non-linear digital filtering technique, frequently used to remove noise from images. It is mostly useful to reduce speckle noise and salt and pepper noise. Its edge-preserving nature makes it practical in cases where edge blurring is undesirable.

The median filter is defined as follows: To compute the output of a median filter, an odd number of sample values are ranked, and the median value is used as the filter output. It is reasonable to assume that the signal is of finite length, consisting of samples from X(0) to X(L-1). If the filter's window length is N=2k+1, the filtering procedure is given by:

$$Y(n)= med[X(n - k),..., X(n),..., X(n + k)]$$

Where X(n) and Y(n) are the input and the output sequences, respectively. This is the non recursive Median filter. It has been first shown that any sequence of length L is converted under repeated median filtering to the root signal after at most (L - 2)/2 passes[2].

RESTORATION METHODOLOGIES EVALUATION:-
With the knowledge on how filters having the capabilities to fulfill de-noise and de-blur operation from a degraded captured image, the comparison of various filters mentioned in the report will be compared. In this section the focus will be on Salt and Pepper and Gaussian noise that commonly occur during image acquisition.

SALT AND PEPPER NOISE:-
Salt and pepper degradation which is also termed as impulse noise or binary noise can be caused by sharp and sudden disturbances in the image signal. The appearance is randomly distributed with white and black (or both) pixels over the image.
The PDF of impulse noise is given by,

$$p(z) = \begin{cases} P_a & for\ z = a \\ P_b & for\ z = b \\ 0 & otherwise \end{cases}$$

For b > a, the intensity of b will appear in the image as white dot. Conversely, level a will appear as black dot. The impulse will be termed as unipolar if either or appear to be zero. The image will become further degraded as the density of noise is increased and making it impossible to be recognized [1].

CLEAN UP ON SALT AND PEPPER NOISE:-
The image is doped with 50% noise density and result of using 7 X 7 averaging and 9 X 9 averaging filtering techniques is shown. From the output result, it has proven that noise can be minimized by using a low-pass filter as the filter gets larger however it contributes to the blur effect on the image.

ii) GAUSSIAN NOISE:-
Gaussian also known as normal noise models, which is caused by random fluctuation in the signal. The mathematics tractability of Gaussian involves both spatial and frequency domains that are best used for situations in which for marginally application. The PDF of Gaussian random variable, , is given as z

$$P(z) = \frac{1}{\sqrt{2\pi\sigma}} e^{-(z-z)^{-2}/2\sigma^2}$$

Where Z represents intensity, Z is the mean and σ is the standard deviation [1].

## VI. SEGMENTATION METHODOLOGIES EVALUATION

In this section, we are going to compare the relative performance for Sobel, Prewitt and Canny edge detectors. The objective is to produce the clean edge by extraction of the principal edge features of the vehicle image. In figure 4.3, the different types of edge detector present the edge information with threshold level varies.

The experiment result has shown that Canny Edge Detection is powerful and better than Sobel and Prewitt

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detection technique in displaying the edge information for various kinds of vehicle. When the threshold level changes to 0.05, the edge information presented by Sobel and Prewitt is satisfactory for the classification purpose.


Fig 1 Edge Detection Technique
(a) Sobel Edge Detection with different threshold level (b) Prewitt Edge Detection with different threshold level (c) Canny Edge Detection different threshold level and sigma level of 0.05.

However, the threshold level of more than 0.05 proved that both techniques contribute to edge information loss and deviate further to extract the primary edge information of the vehicle if threshold level is much higher.

The Canny detection proves otherwise and presents the clean edge information when the threshold level reaches 0.15. The interest of edge information here is the competence in extracting out fine detail such as side mirrors, wiper, headlight and even texture pattern of the vehicle body. The next step is to apply canny detection technique with the presence of noise interference. Figure shows the edge information being extracted with the presence of salt and pepper and Gaussian noise.

PIXEL-BASED TECHNIQUES:-
Pixel-based, also termed as point-based segmentation, is considered as the simplest approach by the detection of isolating points embedded in the region of constant or near constant intensity of an image. The detection can be achieved by applying a mask through the image. Figure 3.14 shows a 3 X 3 mask which can be processed to compute the sum of products of the coefficients with the intensity levels contained in the region of the mask.

The response of the mask is given by

$$R = w_1 z_1 + w_2 z_2 + \ldots + w_9 z_9 = \sum_{i=1}^{9} w_i z_i$$

Where the intensity of the pixel is associated with the mask coefficient. The response of the mask is being defined with respect to the center of the image [1].

FEATURES:-
It offers general-purpose license plate reading from digital pictures of any type of source. It provides high quality car plate recognition for very different type of images and plates with default settings. 98.5% recognition rate (correct reading/total number of input).

**VII.BLOCK DIAGRAM:-**

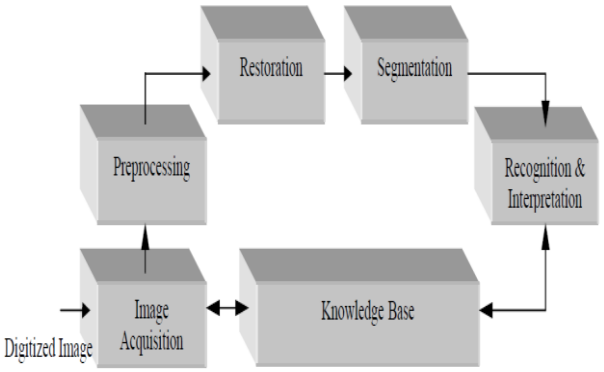


Fig.2 Block Diagram

**FUNDAMENTAL STEPS:-**

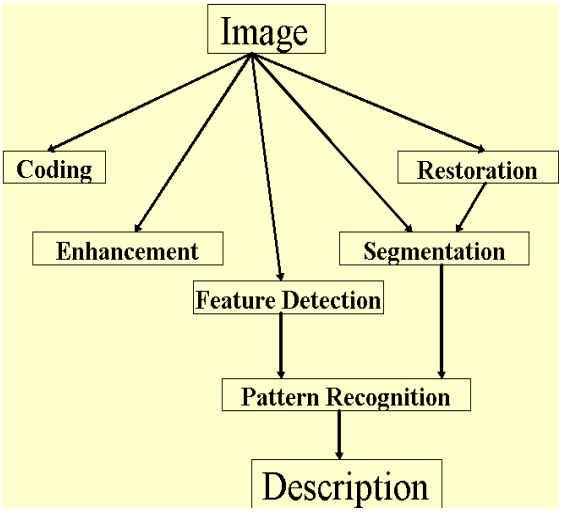


Fig.3 Fundamental Steps

Fig.4 Low-pass filtering technique. (a) Image is corrupted with 50% of noise density (b) Using of 7 X 7 average filter (c) Using of 9 X 9 average filter (d) Original Image


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## VIII.CONCLUSION

A problem of Salt and Pepper noise and Gaussian has been considered in experimental findings. The Low pass filtering is expected to remove salt and pepper noise which contains high frequency components of an image. The result after going through low pass filtering produces smeared images. Alternatively, using of Median filtering produces vast improvement in image recovery using a 3x3 or even larger filter mask. However, larger filter size window tends to blur the image. It has been seen that vast wealth of information has been discussed on Electronic toll gantry and different types of filtering techniques for removal of noise, motion de-blur and classification of vehicles by edge detection. This essential information is important for accomplishment to this project.

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