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# STUDY OF EDGE DETECTION TECHNIQUES IN AUTOMATIC LICENSE PLATE RECOGNITION (ALPR)

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**Abstract -** *Automatic License Plate Recognition (ALPR) can be identified as a technology which has been developed mainly based on Image Processing methodologies. It is being widely used in identifying vehicles in applications such as red-light enforcement, over speeding, bus lane control, motorway road tolling, border control and access/parking control.One of the steps in ALPR is edge detection. It refers to the process of identifying and locating sharp discontinuities in an image. The discontinuities are abrupt changes in pixel intensity scene. Edge detection is an important technique in many image processing applications such as object recognition, motion analysis, pattern recognition, medical image processing etc. Edge detectors form a collection of very important local image processing method to locate sharp changes in the intensity function. Image Edge detection significantly reduces the amount of data and filters out useless information, while preserving the important structural properties in an image. In this paper we have discussed some of the edge detection methodologies like Sobel, Canny and Harris corner algorithms and compared. The results shows the accuracy depends on the conditions of the image.*

***Key Words***: **Edge detection, ALPR, Sobel edge detector, Canny edge detector, Harris corner edge detection**

## 1. INTRODUCTION

Automatic License Plate Recognition (ALPR) can be identified as a technology which has been developed mainly based on Image Processing methodologies. Basically, the License Plate Recognition (LPR) process is divided into three main parts: Plate Detection, Character Segmentation, and Character Recognition. Each of these parts plays an important role in the final accuracy. Many problems such as size variations, viewing angle, low contrast plates, vehicles high speed and time consuming algorithms have prevented researchers from introducing a single class of algorithms to solve the problem. Edges are the boundaries between object and background. It is basically the image segmentation technique which divides the spatial domain and defines the image into meaningful parts. With the help of edge detection one can easily detect the features of an image which indicates the end of one region in the image and beginning of another indicating the change in gray level. There are an extremely large number of edge detection operators available, each designed to be sensitive to certain types of edges. Edge detection is difficult to implement in noisy images, since both noise and edges contains high frequency content. Monochrome camera sensors are capable of providing higher details and sensitivity compared to color camera sensors. An IR projector increases the contrast between plate's characters and plates backgrounds. The IR projector is mostly useful at night to brighten the plates. We also need to synchronize the camera exposure time with the IR projector pulses in order to capture images with clearer plates. To capture individual features like lines, corners, circles and other geometric structures methods are applied to the image which also completes the distorted structures. Over the time, applications of the ALPR have spread into security establishment applications such as criminal activity monitoring and smuggling identification systems other than the widely used applications of traffic control and tolling all around the world. An important feature of the Number Plate Recognition system is to keep record of the vehicle's number plate image for other process if further required. If there is identification or verification process involved with application, the system will need to be connected to the respective database in order to achieve required outcome. Among these main steps, the most significant part is usually the image pre-processing step which enhances/improves the input image to a level that characters can be segmented in a correct method. Therefore, the reliability and accuracy of the ALPR systems rely on the methods that used in pre-processing. Based on the importance of the pre-processing steps used in approaches to ANPR, the aim of this paper is to compare various edge detection techniques involved in the process of plate recognition. Mainly four different edge detection filters will be used in turn by applying them on same input image. Sobel, Canny and Harris corner edge detection are compared. The algorithms are compared for accuracy as well as processing times.

## 2. DESIGN

Edge detection is an important technique in many image processing applications such as object recognition, motion analysis, pattern recognition, medical image processing etc. Edge detection is the mathematical method which aims at finding the changes in brightness in image which is used for capturing the important event.
Steps Involved in Edge Detection involves three major steps which are filtering, enhancement and detection as follows:-

(a)**Filtering**: images are often corrupted by noise which is a variation on intensity values, common types of noise are salt and pepper, impulse and Gaussian noise. However the more filtering done to reduce noise results in loss of edge strength.

(b) **Enhancement:** To facilitate the detection of edges, it is important to determine changes in intensity in the neighbourhood of a point. Enhancement emphasizes pixels where there is significant change in local intensity values and it's performed by computing the gradient magnitude.

(c)**Detection**: It points the image that have a non-zero value for the gradient and not all of these points are edges for a particular application. So a method is created to determine which points are edge points. Frequently, thresholding provides the criteria used for detection.

### 2.1. Sobel edge detection

It is also known as 'Sobel-Feldman operator' since the algorithm was developed by Irwin Sobel and Gary Feldman. This algorithm acts as a discrete differentiation operator, while computing an approximation of the gradient of the image intensity. Hence, this operator will build a gradient vector or a norm of the same in each point of the image as an output. The Sobel operator is regarded as a classical edge detector. It convolves the image using small integer valued filter in horizontal and vertical directions using a 3x3 mask for each direction. Sobel operator is one if the pixel based edge detection algorithm. It can detect edge by calculating partial derivatives in 3 x 3 neighborhoods. The detection of LP in starts by enhancing the image, then applying Sobel operator to find vertical edges, followed by unwanted edges elimination and finally, the plate region is extracted. In the vertical Sobel edge detector is applied on the input image to give the resultant edge image, followed by unwanted vertical edges filtering and vertical edge matching compared to the known plate aspect ratio of a plate. The edge enhancement methods clearly show a good LP extraction rate and a fast extraction time.

### 2.2. Canny edge detection

It was developed by John F. Canny; canny operator was used to detect wide range of edges in an image with the help of a multi stage algorithm. In order to meet the criterions of capturing edges with a minimum error rate, detected edge point should be accurately localized at the center of the edge by the operator and an edge should be marked only once whilst preventing false edges being created. The Canny edge detector is classified as a Gaussian edge detector. This is because the filter is approximated by first-order derivatives of Gaussians. Firstly, the image is smoothed to eliminate any noise; it then finds the image gradients to emphasize regions with high spatial derivatives. These regions are tracked and any pixel within the region that is not at the maximum is suppressed. At this point hysteresis is introduced to track along the rest of the pixels that have not been suppressed. Two thresholds are set for hysteresis, which are compared to the gradient magnitude to find edge and non edge. The first and most obvious is low error rate. It is important that edges occurring in images should not be missed and that there be no responses to non-edges. The second criterion is that the edge points be well localized. In other words, the distance between the edge pixels as found by the detector and the actual edge is to be at a minimum. A third criterion is to have only one response to a single edge. This was implemented because the first two were not substantial enough to completely eliminate the possibility of multiple responses to an edge.

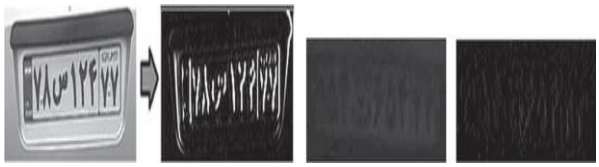
### 2.3. Harris corner edge detection

Harris Corner detection technique is proposed which is robust in light of the fact that it manages the corner focuses and diverse brightening condition won't influence the corners of the image. License plate have characters and clearly the characters have numerous corners then another region on the vehicle. So by applying better handling ventures of Harris corner, one can proficiently detect LP. There are two important parts of the ALPR system. It involves the plate detection and segmentation for recognizing the license plate in ALPR system. Initially a picture was taken by a camera and it was considered as an input image. After reading the image, detection part is carried out and then the detected plate region is feed forward for the segmentation.

## 3. EXPERIMENTAL STUDY

**Table -1: Comparision table for edge detection techniques**

| Comparision table | | | |
|---|---|---|---|
| Edge detection techniques | Sobel | Canny | Harris corner |
| CPU time | 1.2480 | 1.7628 | 1.7320 |
| Accuracy | 75% | 87.5% | 93.84% |



(a) (b)

**Figure 1 Output of sobel edge detection for (a)clear plates (b) dirty plates**

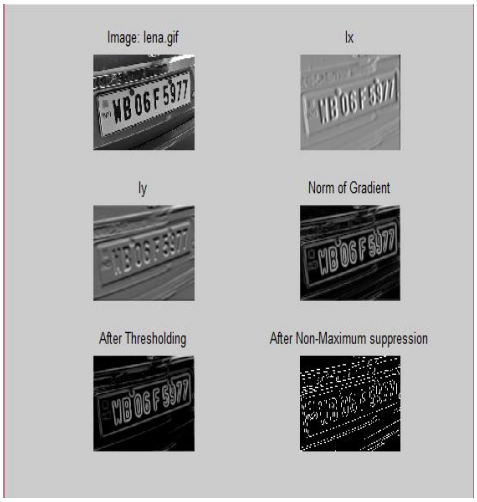



**Figure 2 Output of canny edge detection**


**Figure 3 Output of harris corner edge detection**

## 4. APPLICATIONS

### 4.1 Image matching

To evaluate corner detection algorithm is ultimately to guide utilizations. Image matching, recognizing the homologous pixels between two images or among multiple images by certain matching algorithm, is an important application field of corner detection through which can greatly reduce the matching data.

### 4.2 Machine learning

Machine learning can be which can fully process live PAL video using less than 7% of the available processing time. By comparison neither the Harris detector (120%) nor the detection stage of SIFT (300%) can operate at full frame rate. Clearly a high-speed detector is of limited use if the features produced are unsuitable for downstream processing. In particular, the same scene viewed from two different positions should yield features which correspond to the same real-world 3D locations.

### 4.3 Spatial representation

Spatial representation useful in image processing applications. It is used for identification of shark fish image. It is well suited for a specific spatial location in distinctive between the objects of an image. The main important activations can be extracted from the space in order to create a sparse object representation.

### 4.4 Coastline boundaries

The Canny edge detector speeds up the convergence of iterative Gaussian curve fitting process and improves the accuracy of the bimodal Gaussian parameters. Particularly, grouping and labelling contiguous image regions into individual image objects enables us to utilize heuristic human knowledge about the size and continuity of the land and ocean masses to discriminate the true coastline from other object boundaries. The final product of our processing chain is a vector based line coverage of the coastline, which can be readily incorporated into a GIS database. Method has been applied to both radar and optical satellite images, and the positional precision of the resulting coastline is measured at the pixel level.

## 5. CONCLUSION

Since edge detection is the initial step in object recognition, it is important to know the differences between edge detection techniques. The software is developed using MATLAB 7.0. The performance of the Canny algorithm depends heavily on the adjustable parameters which is the standard deviation for the Gaussian filter, and the threshold values which also

controls the size of the Gaussian filter. The larger the scale of the Gaussian, the less accurate is the edge detection. Canny's edge detection algorithm is computationally more expensive however, the Canny's edge detection algorithm performs better. Based on the literature survey and simulation outcomes the Harris corner detection performs proficiently on an input image file captured throughout the several timings and with diverse lighting conditions. License plate detection was achieved successfully. Harris corner edge detection is having more accuracy compared to sobel and canny edge detection. Sobel edge detection has less CPU time compared to canny and harris corner edge detection.

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