Automated Parking Management System for Identifying Vehicle Number Plate

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Article Info	ABSTRACT
	By using image processing, the Automated parking management system (APMS) to recognize the license plate number for efficient management of vehicle parking and vehicle billing. It is an independent real-time system, reduces number of people involvement in parking areas. The main aim of this system is to automated payment collection. This (APMS) system extract and recognize license plate numbers from the vehicles, then that image is being processed and used to generate an electronic bill. Generally in the parking lots heavy labor work is needed. This system used to decrease the cost of the labor and also enhance the performance of the APMS. This system is composed of vehicles license plate number extraction, character segmentation and character recognition. A proper preprocessing is done before extracting the license plate and it also generates the entry time and exit time of the vehicle and finally generates the electronic bill.

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1. INTRODUCTION

In image processing, computer vision and pattern recognition algorithms, segmentation is most important and basic step [1, 2]. Segmentation of image is the first step which has large application in the fields of robotics, automations, satellite imaging and license plate recognition [3, 4].

Now-a-days, the license plate recognition is widely used in the management of traffic to recognize a vehicle whose licensor violates the traffic rules and it also helps in finding the theft vehicles it doesn't needs any manual work. In this system when the vehicle i.e., car enters in the parking lots a digital camera with sensor is fixed and license plate recognition system is recognize a license plate number of the specific car. It also enters the car details and entry time, at exit time it automatically calculates the parking price. It is the most suitable and efficient way to avoid the labor work [5, 6, 7, 8].

The rest of the paper is organized as follows. Analysis and Study of System are discussed in Section 2. In Section 3, design of Parking Management System is discussed. Methods used in the proposed method are given in Section 4. The proposed automated parking management system is given in Section 5. In Section 6 experimental results are presented. Section 7 concludes the paper.

2. ANALYSIS AND STUDY OF SYSTEM
2.1. Existing System

Now-a-days, parking places depended on labors [9]. They need to maintain data of all the vehicles by physically entering the information. It includes high prices. Disadvantages are the Precious time wasted due to the inconvenient and ineffectiveness at parking places and more consumption of fuel while idling or driving around the parking places [10].

Komarudin et al. [3] designed and analyzed the license plate identification through a digital images using desktop peripheral and binary calculation methods using adaptive threshold and global threshold. Kongurgsa et al. [11] proposed real-time intrusion, detecting and alert system by image processing techniques. Yiman et al. [7] aimed to solve the problem of identifying the vehicle license plate number at the parking lot. Wen et al. [12] proposed license plate recognition on the basis of a novel shadow removal technique and character recognition algorithm. Using a binary method, it removes the shadow within the image, which is based on the improved Bernsen algorithm combined with the Gaussian filter and for character recognition SVM integration is used. This system also consists of the improved techniques for image tilt correction and image gray enhancement. Generating the parking bill in parking slots and toll gates in highways has become major problem. One of the solution is to propose an automated license plate recognition system. There are numerous recognition systems available which are designed using different methods but still some features are to be explored like vehicle speed, different environment conditions can effect the system recognition rate. The proposed system has overcome the drawbacks of the existing system.

2.2. Proposed System

To reduce the involvement of man power in the parking lots by changing it into an automated process by providing fast and efficient parking management. The automated parking management system made up of 2 stations. One is at entry and the other is at the exit at the parking places. These stations are linked to main processing for the generation of parking bills depending on its time.

3. PARKING MANAGEMENT SYSTEM DESIGN

Parking management system architecture is shown in Figure 1. The license plate recognition system consists of five phases:

- **Image Acquisition**: It captures the image and forwards the image to the next phase in the number plate recognition system.

- **Binarization**: It converts the image into gray-scale image.

- **Noise Removal**: It removes the noise from the vehicle number plate.

- **Image Processing**

  - Character Segmentation: It extracts and divides all the characters into individual images from the license plate images.
  - Character Recognition: It verifies the obtained characters with the database

- **Storing into Database:** It stores the license plate number with input time into the database.

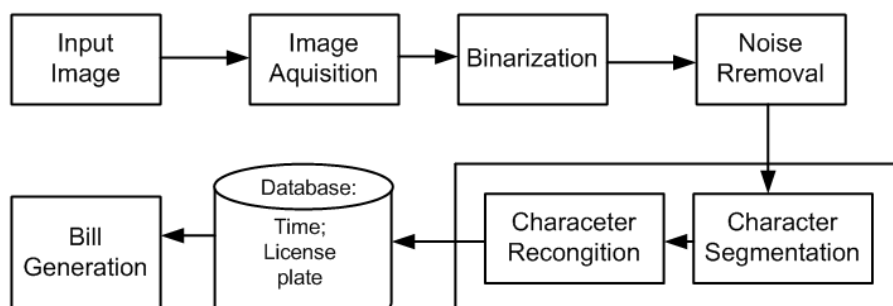- **Bill Generation:** It generates the bill amount based on time at the exit station.

Figure 1. Parking Management System Architecture

4. METHODS USED

In this section different algorithms used to implement number plate recognition system are discussed.

4.1. Edge based segmentation

Edge based segmentation, it is the position of pixels in the image that have the close similarity to the boundaries of the objects seen in the image [13, 14]. It is then assumed that since it is a boundary of a region or an object, it is closed and that the number of objects of interest is equal to the number of boundaries in an image. For correctness of the segmentation, the perimeter of the boundaries detected must be approximately equal to that of the object in the input image [15]. For instance, the methods having problems with images that are:

- Edge-less

- Additional noise

- Smooth Boundary

- Texture Boundary and so on.

The other problems of these techniques are emerge from the failure to adjust/ calibrate gradient function accordingly thus produces undesirable results as:

- The region which is segmented might be smaller or greater than the original.

- - The edges of the segmented region might not be connected over or under-segmentation of the image (arising of bogus edges or missing edges)

4.2. Region growing algorithm

This algorithm is an easy region-based image segmentation procedure which is further also categorized as a pixel –based image segmentation procedure therefore it involves in the selection of initial seed points. This approach to segmentation inspects the neighboring pixel of that initial seed points and it will decide whether the neighbors should be added to the region or not. It process go through again, in the same manner as a general data clustering algorithms. The basic disadvantages of histogram-based region observation is that the histogram provides no spatial information (only the distribution of gray levels). It utilize the foremost certitudes that the pixels which are closed with each other have similar gray values [16, 17].

This region growing approach is quite opposite of the split and merge approaches where the initial set of small regions are repeatedly merged according to the similarity constraints. It starts by choosing an arbitrary seed pixel and the region is grown by adding the seed pixel with the neighboring pixels which are similar to each other, and increases the size of the area or region. When the growth of the one pixel is stop then it choose another seed pixel which is not yet belongs to the region which is already used and then start the same process again. This entire process is continue until all the pixels belongs to some of the region. Region growing methods mostly gives good segmentation that correlates well to the noted edges [18].

4.3. Region-Based Segmentation

The main objective of segmentation is to divide an image into region [19]. Some of the segmentation methods such as thresholding, the objective of this method is achieved by looking the boundaries of the region based on the interrupt in the gray level or color properties. Region based segmentation having the ability to determine the region directly [20].

4.4. Character Recognition

Low resolution template matching method is acquired, mainly by using the low pixel resolution to represent an image and template that to be recognized [21]. Each matrix elements that correlates to a sub-matrix in high resolution matrix. The element's value is the average of the pixel gray values that correlates in high resolution sub-matrix. Comparing with the high resolution matching algorithms, the true identification rate of the each character and numbers is considerably increased. The cause is that if the resolution goes through a moderate reduction, then the error produced by the image distortion and noise will be reduced. The recognition error of the letters and the numbers mostly occurs in few characters with very similar main structures but some detailed differences such as B and 8, O and 0, S and 5 [22].

4.5. Correlation

The measure of degree to which two variables are agreed, not require in actual values but in general behavior [23, 24]. The two variables are the corresponding to the pixel values in the two images, templates and origin.

$$\rho_{I,J} = \frac{E[(I - \mu_I)(J - \mu_J)]}{\sigma_I \sigma_J} \tag{1}$$

where I, J are the variables of the corresponding pixel values of images, E, μ & σ are covariance, mean and variances.

4.6. Template Matching

It is a technique used to classify objects. Template is a small image or a sub image. The main objective is to find phenomenon of this template in a larger image that is to find the matches of this template in the image. Template matching approaches compare the part of the images against one another [25, 26]. Sample image is used to identify similar objects in the origin image. It has been a classical approach to the complications of locating and identifying an object in an image. This techniques especially in2-D cases has many applications in object tracking, compression of an image,stereo correspondence and other computer vision applications. There are several matching methods but normalized cross correlation and the square root of sum of square difference are used as the measure for similarity. Moreover, many other techniques to match the templates, such as sum of the Absolute Differences and sequential similarity detection algorithm are acquired in many applications for pattern recognition, video compression, etc., Additionally, this template matching method has been vastly used in various applications, for example, extraction of container identity code image segmentation, etc., The correlating pixel values in the template and origin images are compared using this algorithm to identifying the characters on the vehicle license plate [27, 28].
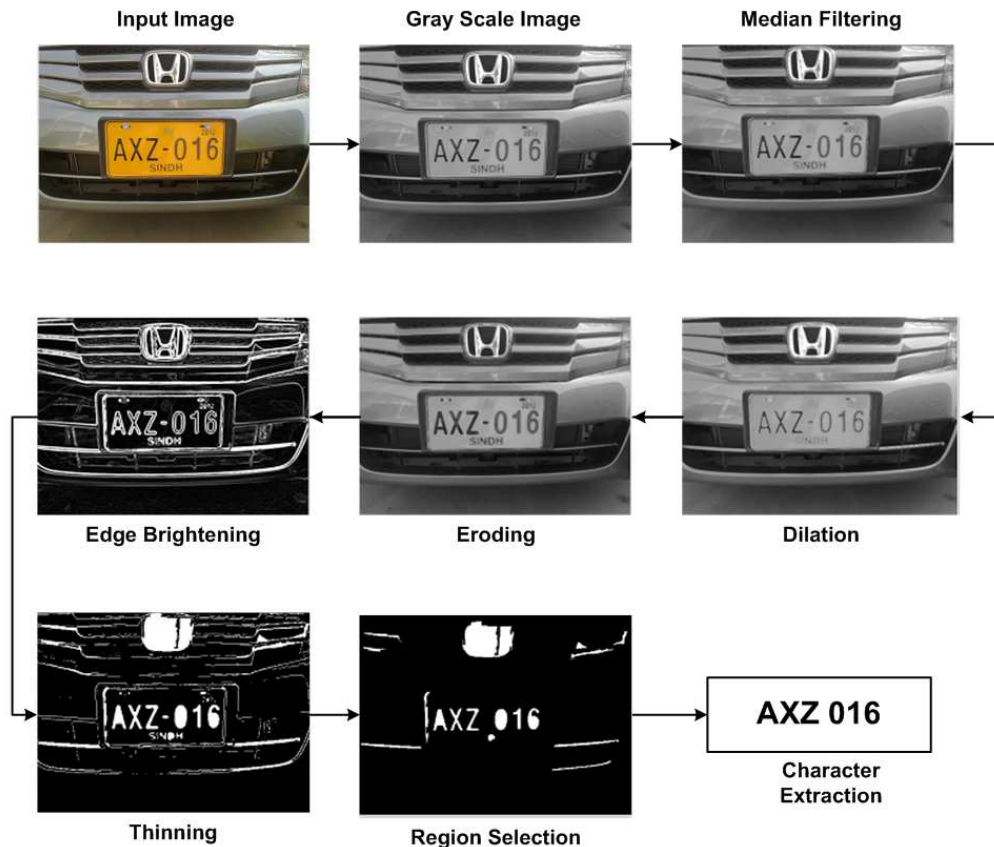

Figure 2. Proposed Parking Management System

5. PROPOSED METHOD

In this section, step by step process of automated parking management system is discussed and is shown in Figure 2.

Step 1: Initially, the vehicle image is captured and is considered as input image.

Step 2: The input color image is converted into gray-scale image to identify important features of the image (i.e.,edge information) and also shades of gray-scale image gradually changes from byte to byte .

Step 3: Median filter is applied on the gray-scale image to reduce the noise like salt and pepper from the images where it reduces noise and preserve edges.

Step 4: Morphological image processing is done on the median filtered image since the image may contain numerous imperfection. Dilation and eroding operations are applied using structural element. For probing and expanding the characters in the image dilation is used and for shrinking eroding is used. Morphological image is generated by subtracting the eroding image from dilation image for edge enhancement.

Step 5: Edge brightening is done on the morphological image for easy extraction of the characters and is converted into binary image.

Step 6: Further, thinning is applied on the binary image to fill the entire characters in the license plate.

Step 7: Selection of a region: It removes all the small objects from the binary image and selects the particular region in the license plate i.e., Characters with in the license plate.

Step 8: Finally at the entry station, the extracted characters i.e., license plate number and entry time are stored in the entry level number plate database.

Step 9: At the exit station, the steps:1-8 are repeated, the extracting license plate number and exit time are stored in the exit level number plate database.

Step 10: Using template matching algorithm, the characters of the entry and exit number plates are compared with the help of correlation.

Step 11: After matching, the parking bill is generated based on the entry and exit time based on parking bill rates.

Parking Bill Rates

- 40 rupees for first one hours of parking

- Extra 20 Rupees for each additional hour

- Extra 50 rupees after six hours

- Selection of the vehicle beyond a minute is charged as an hour

- 1000 Rupees for each 24 hours

6. EXPERIMENTAL RESULTS

In this simulation, Parking bill is calculated for 50 images of license plates. The output is shown for 4 license plate images as shown in Figure 3. The preprocessed number plate is given as input and after processing the output is given and stored in the database. The parking bill is calculated based on the entry and exit time. Table. 2 provides the efficiency of the proposed parking management system. On an average of 95.23% is achieved in recognition of license plates for the proposed system.

Table 1. Parking Bill Rates for 1 Day

HOUR	PRICE in Rs	HOUR	PRICE in Rs	HOUR	PRICE in Rs
1	40	9	290	17	690
2	60	10	340	18	740
3	80	11	390	19	790
4	100	12	440	20	840
5	120	13	490	21	890
6	140	14	540	22	940
7	190	15	590	23	990
8	240	16	640	24 (1 DAY)	1000

License Plate	Processing	Recognition	Date/Time (Entry)	Date/Time (Exit)	Price In Rs
AXZ-016 SINDH	AXZ 016	AXZ016	20/03/18 07:40	20/03/18 09:44	60
AFR-420 SINDH	AFR-420 SINDH	AFR420	24/03/18 20:05	24/03/18 08:43	490
AKH-343 SINDH	AKH-343 SINDH	AKH343	28/03/18 18:30	28/03/18 00:23	140
AWR-310 SINDH	AWR 310 SINDH	AWR310	31/03/18 10:00	31/03/18 23:40	540

Figure 3. Result

Table 2. Accuracy Rate

Detection	License Plate Recognition	Generation of Parking Bill
Correct	87%	100%
Error Rate	13%	100%
Average	95.23%	100%

7.   CONCLUSION AND FUTURE SCOPE

In this system, vehicle license plates are designed as the crucial task for parking management system. It performs a crucial task in future traffic control and parking system. This system studies the license plate recognition of the vehicles based on neutral networks. The recognition task is performed on 50 license plate images of the vehicles, out of 44 are matched successfully on an average 87 percent which is a great success rate, thereby fulfilling the principles of the about tasks. Key element of the system are successfully designed and implemented. The proposed system recognizes the license plate and generates the parking bills along with its entry-time and exit-time of the vehicles. License plates recognition system has many applications. These can be used at the parking lots where the parking of the vehicle is done without wasting time, and there is no need for involvement of man power. This system can also be used at the toll gates in the highways and also used for identifying the vehicles which is are not following the traffic rules, also in finding the theft vehicles by maintaining this systems on the highways for locating the vehicles. Using this manual work can be reduced thus it improves the efficiency of the parking system.

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