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A FUZZY BASED DEEP LEARNING MODEL TO IDENTIFY THE PATTERN RECOGNITION FOR LICENSED PLATES IN SMART VEHICLE MANAGEMENT SYSTEM

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Abstract

In general, vehicle management is based on the proper maintenance and safety of a vehicle. Based on this the quality of the vehicle is calculated. Most of the older vehicles are currently of poor quality and are producing high levels of pollution. Thus, it is necessary to find information about those vehicles. The number plate is helpful to find the information about the vehicle. In this paper, the number blood detection method is proposed. It is based on the fuzzy model and developed in the way of deep learning. Its main purpose is to provide accurate vehicle details from a given set of data. It has also been upgraded to provide its safety measures to its owner based on the vehicle data. Thus, this proposed model prevents major accidents. These functions can also be very helpful in recovering vehicles based on data from stolen vehicles.

Keywords:

Vehicle Management, Fuzzy Model, Deep Learning, Number Plate

1. INTRODUCTION

The system for automatic licensing plate authentication may include a software package with multiple devices and various analysis functions, depending on the manufacturer and the model, or the software package that serves different devices [1]. Only the old number can be used to use only the old number if it retains the appropriate appearance. The number should not be shortened or destroyed [2]. According to the rules, the numbers should be read from 20 meters away. So, all the letters and numbers in them should be clear [3]. The signs of license plates are carried out in the same field being handed over [4]. In this case, the vehicle has the right to apply for any unit convenient for him. It does not depend on where the car was recorded. Every day the traffic jam is increasing [5]-[6]. Thus, the traffic congestion is caused by disadvantages including disadvantages of vehicles. As a result, micro-damages to accidents and cars have become common and every day [7]. When buying a vehicle, the future owner did not show a little more interest in the cost of painting it, but this issue is very important [8]. The cost of painting a whole car will be half of the vehicle price [9]. Therefore, if the scratches, the microscopes such as crushed stone, the micro-Dames such as chips, abrasions, paint on damage or damaged area will be a rational solution [10]. In addition to the aesthetic character, car painting makes a security function, which means it protects the car body from erosion. Therefore, the car is immediately worthwhile; otherwise, the owner will have more expenses to reset its vehicle [11]. But to draw a separate part of the damaged car, you need to know the colour number of the car. Car paints are currently mentioned in a large number of colours and shades, and manufacturers have created static plates with numbers [12]. Each car brand has its plate. In most cases, the imported car paint number is different from the domestic car paint number [13].

Keep the number for a while; you do not have to be subject to additional diagnosis. If your plates give the traffic police, only requires the application for storage [14]. This is the only document that confirms the truth of the transfer [15]. Documents, forms, certificates or receipts will not be provided in the section [16]. Therefore, the application is recommended to take a photo and take a copy.

There are significant advantages that providing a license plate authentication system:

- Significant increase in the level of security and control of road traffic in the facility;
- The possibility of entering the third party protected area using fake or stolen magnetic basses or electronics key fibre. (Steal a car, but it is very difficult);
- Automatic report of vehicles with the ability to create multiple statements;
- Remote access skills allow the company to control the work of the company;
- The license plate authentication system can be easily integrated into the overall access control system [17]-[20].

The possibility of entry into the boundaries of the protected facility by sticking to the car number in the printer is completely excluded [21]. Almost all licensing gallery authentication systems control the light reflection on paper. The post-pasted number is simply readable. The purpose of automated license plate authentication systems is very different [22]. First of all, car number recognition service stations, gas stations, car washing, warehouses, companies, and parking parks are useful. Operations such as automated license plate authentication systems are very different:

- Entrance and exit control in the controlled territory;
- Control to departure from the company area, for example, a bus station, non-payment customer;
- Monitoring the service area loading.

The VIN code is the unique number of your vehicle, which has its specific parameters (producing country, mechanical, body, assembly, model number) [23]. The main objective of assigning the VIN code is to protect it from theft. Therefore, according to the ISO 3779 standard rules, the VIN code printed on the metal plate must be established as unimportant without causing damage to the vehicle [24]. Thus, the VIN code will be until all the vehicles are scrapped. It easy to find VIN [25].

If you are connected to access control systems, the license plate identifies additional benefits [26]. First of all, it is complete control of the location of vehicles in the company loading area. It helps monitor the exports of imported or finished goods of raw materials, check the efficiency of loading and unloading processes and prevent theft [27]-[28]. At the same time, not only at the entrance but also the car number at the exit excludes the possibility of exporting items using fake or false documents [29]. But the parking or car parking owner receives more benefits. Combining the license plate authentication with the fees completely removes the possibility of abuse or theft of the staff [30]. It will completely remove the possibility of errors in calculating the amount of money spent on the parking lot; will give iron evidence in the dispute with dishonest customers.

2. LITERATURE REVIEW

Shashirangana et al. [1] discussed the streaming protocol, and it allows you to use the information and use the video in real-time. Such devices are at least 550 TVL to recognize the car number, which is provided by 1/3 760H Matrix.

Zheng et al. [2] discussed the identification length of the visual system. The focal length is 9-22 mm. It can be identified at a substantial distance. The camera light sensitivity must be as high as possible from 0.001. The device must be equipped with the IR light, which allows at least 15-20 m away from the distance.

Bhushan et al. [5] expressed the cameras are used exclusively on the outside, so it is mandatory with the built-in thermal comers with built-in thermocouples to allow the device to act at the temperature of at least-30 degrees Celsius.

Puranic et al. [8] discuss that black and white cameras than colour cameras are highly sensitive and clarification is recommended to using them. In addition, most licensing authentication methods change the colour image from the camera to black and white.

Chen et al. [10] discussed the main parameter shutter speed is the handbook system that you need to focus on when selecting a place to install CCTV cameras for licensing plate authentication.

Wen Y et al. [12] expressed the linear contact between the vehicle speed and the recommended shutter speed. With the high speed of the car, exposure time should be less, otherwise, the frame is blurred - the movement is dimmer. However, the maximum allowable shutter speed depends not only on the time of expression but the angle of the camera.

Ullah F et al. [13] discussed the camera angle. The camera installation angle is the angle between the vehicle travel direction and the camera optical axis. Most intermittent cameras are capable of sending 80-pixel wide license plate images to accounts for approval at the vertical installation angle and +/- 30° horizontal distortion angle. Horizontal (road hardness) +/- 10°, if the license plate has been recognized, it is considered a good indicator

3. PROPOSED METHOD

The proposed Fuzzy based number plate recognition (FNPR) is a technology that uses optical writing recognition on images to read vehicle registration plates to generate vehicle location data. It is specifically designed for existing closed-circuit television, road rule enforcement cameras or cameras. The process of the proposed system is shown in Fig.1.

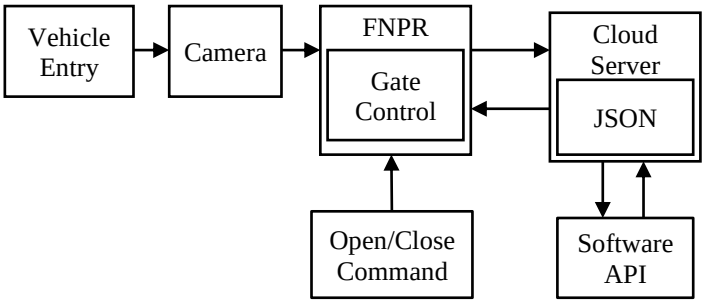

Fig.1. Proposed FPNR block diagram

FNPR is used by police forces around the world for law enforcement purposes if a vehicle is registered or licensed. The Pay-per-app utility is used for electronic toll collection on roads and as a method of listing traffic movements, for example by highway systems. The fuzzy number-plate authentication can be used to store images captured by cameras, as well as texts from the license plate, and some configurations for storing a photo of the drive. Systems generally use infrared light to allow infrared light to be used to take pictures at any time of the day or night. This concern about these systems has centred on privacy issues tracking citizen movements, erroneous, high error rates and increased government spending.

Algorithm: Fuzzy based number plate recognition (FNPR)

Step 1: Capture the vehicle image

Step 2: Identify the number plate in the captured image

Step 3: If (number available)

Step 4: Check the vehicle number in the allocated DB

Step 5: Send the vehicle details to the owner

Step 6: Else search for an alternate image of the vehicle

Step 7: Go to step 3

Step 8: End

The computer software feature runs on standard home computer hardware and can be integrated with other applications or databases. It first detects the image of the image plate, uses a series of image manipulation techniques for normalization and enhancement, and then extracts the alphanumeric of the fuzzy character recognition (FCR) license plate. The FNPR systems typically use one of two basic approaches: allowing an entire process to be performed in a real-time LAN location, and sometimes sending multiple images from a remote computer location and sometimes performing the FCR process shown in Fig.2.

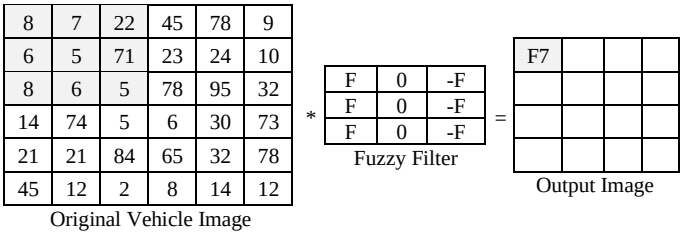

Fig.2. Modified Fuzzy based Convolution Layer

Upon completion of the LAN site, the plate alphanumeric, date-time, LAN identification information, and other required information are completed in approximately 250 milliseconds. If this information is not easily restored, it can be easily sent to a remote computer for further processing or stored at a later cost. In the other arrangement, there are a large number of PCs used on a server farm to handle the high workloads. Often on such computers, the remote server needs to process the images, which may require larger bandwidth media. The linear resolution of the pixels to a meter depends on the resolution of the camera and the camera flavour. This can be calculated using the formula:

$$A_{lin}=A_s/(T\times L\times\beta) \quad (1)$$

where, A_{lin} = linear resolution, pixels per meter, A_s = camera horizontal resolution, β = the angle of camera and L = the distance from the camera.

The license plate brightness and contrast are normalized, and then the characters are extracted to be FCR ready.

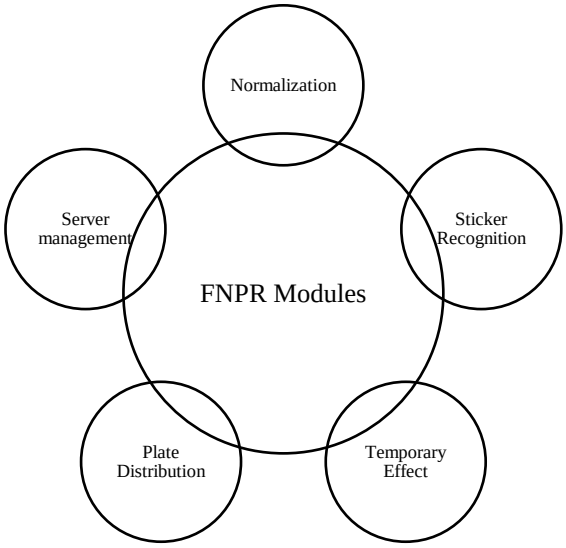

Fig.3. FPNR Modules

- ***Plate Distribution*:** Responsible for locating and isolating plates in film
- ***Normalization***: Adjusts the brightness and contrast of the image.
- ***Stricter Segmentation***: Finds individual characters in Plates. Images make the effect more reliable or confident. Since anyone image may flare up with reflected light, the area is vague or different
- ***Temporary Effect***: The complexity of these subdivisions of the project determines the accuracy of the system. During the third stage (normalization), some systems use edge detection techniques to increase the image contrast between the letters and the plate support. An intermediate filter can be used to reduce the visual noise in the image
- ***Server Management***: *Local Server* - If the file cabinet is used by a server on the computer, it should be on the same server approved by license plates. *Remote Server* - It is located on a particular server on the network. You must specify the server address in the network and the port, the user name and the user password located.

The FNPR uses fuzzy character recognition (FCR) in images taken by cameras. When the vehicle registration plates changed to a different style, one of the changes was to the font, introducing smaller spaces in some letters (such as *b* and *r*) to make such systems even more distinct and clearer. Some license plate arrangements can deal with such differences to make use of variations in font sizes and positioning-up settings useful. More complex systems can deal with international variations, although many projects are designed individually for each country. Road-rule enforcement or closed-circuit television cameras used for cameras, as well as mobile units, are usually attached to vehicles. Some systems use infrared cameras.

4. RESULTS AND DISCUSSION

The proposed Fuzzy based number plate recognition (FNPR) was compared with the existing Automatic license plate recognition (ALPR), Automatic number plate recognition (ANPR), License plate recognition system using neural networks (LPRNN) and Vehicle number plate recognition system (VNPR)

4.1 LIGHT SENSITIVITY

For reliable recognition of car license platforms, the ability to form good light sensitivity and shutter speed in the camera must be manually (shutter speed or shutter speed). This requirement is very important when creating license plate authentication settings for high-speed vehicles. At 30 km paces, this requirement is less important, but it cannot be underestimated. Because the camera should take at least ten frames to achieve high recognition standards.

Table.1. Comparison of Light sensitivity (in %)

Input	ALPR	ANPR	LPRNN	VNPR	FNPR
100	68.11	70.52	40.72	42.38	90.17
200	68.00	70.54	40.55	42.11	89.67
300	67.98	71.42	41.28	42.41	89.79
400	71.08	74.25	44.62	45.92	93.02
500	72.28	75.57	45.35	47.24	93.40
600	72.89	76.40	46.24	47.78	93.97
700	73.30	76.80	46.32	48.08	93.67

4.2 SHUTTER SPEED

The shutter speed should be about 1/200 seconds to identify the Camera license plate at 30 km/hour speeds compared to the camera installation angle up to 10 degrees. For many cheap cameras, even in the cloudy weather, such expression will not be enough, and the picture will become dark / or loud. Therefore, the amount of matrix is worth focusing on its quality. It is best to use an exclusive black and white camera with FCD Matrix. However, their price is very high and the resolution is generally more than 1MP, which imposes severe controls on their compatibility.

Table.2. Comparison of Shutter Speed (in %)

Input	ALPR	ANPR	LPRNN	VNPR	FNPR
100	59.60	74.15	43.23	46.58	90.01

200	61.09	76.12	45.65	48.78	90.00
300	61.89	77.25	46.06	49.58	91.20
400	64.22	78.44	47.66	50.25	91.68
500	65.23	78.83	49.98	51.68	93.11
600	65.87	80.35	51.23	52.77	94.27
700	66.53	80.59	53.96	53.25	95.04

Generally, if not the objective reasons for high resolution, you should not chase it. Relatively cheap Ultra-High Resources Cameras (4MP, 5MP and more) 1/3, 1/2.8 and less often, 1/2.5-inch matrix. The cameras with 1.3- and 2-megapixels resolution have the same matrix. As a result, the number of Photometrical elements in the 1.3MP camera is significantly larger than the 5MP camera, and with the large size, each photo-synthical element can collect higher brightness. That is why we have the recommended IP cameras for 2 megapixels.

4.3 WIDE DYNAMIC LIMIT (WDR)

The camera dynamic limit determines the rate between the maximum and minimum light intensity that its sensor is generally capable of catching. In other words, this is the ability of the camera that sends the flashing and dark areas of the film without loss of the film. This parameter for automatic license plate authentication is very important because the headlights help to deal with the light of the camera. However, sophisticated cameras with 140DB WDR cannot always handle high contrast lights. In this case, the number of visible lights does an additional light or IR range, highlighting the number plate recognized.

Table.3: Wide Dynamic Limit (in %)

Input	ALPR	ANPR	LPRNN	VNPR	FNPR
100	69.49	70.05	43.07	45.57	90.01
200	71.12	71.79	44.65	46.99	91.30
300	71.60	74.13	46.85	48.25	92.31
400	72.89	74.94	48.48	50.24	93.20
500	75.00	77.23	49.62	52.71	93.57
600	76.49	79.16	51.82	54.15	94.61
700	78.30	80.89	52.97	55.87	95.38

4.4 DEPTH OF FIELD

The depth of the field or, fully, the depth of the field (DOF) is the range of objects that are sharpened. This system is determined by focal length, hole and material distance. Because the depth of the field is high, Focus Area is large and more likely to catch enough clear frames of the moving car.

Table.4. Comparison of Depth of the Field (in %)

Input	ALPR	ANPR	LPRNN	VNPR	FNPR
100	68.23	77.79	50.63	54.01	89.27
200	68.56	79.29	51.22	55.88	90.31
300	69.90	80.40	52.20	56.71	90.44
400	71.04	80.78	53.41	57.62	91.40
500	72.09	81.79	54.55	58.54	90.97
600	72.80	82.72	55.66	59.87	92.21
700	74.10	83.72	56.36	60.74	92.32

The maximum effect of the depth of the field is the lens hole. The hole is smaller, and the depth of the field is high; if large, the depth of the field will be less. Our recommended number of Blade recognition cameras can be changed by changing lighting conditions by automatically changing their existence. While the depth of the field is low, the focus of such cameras is recommended to correct the maximum hole.

Do not exceed the depth of the field from the camera, the depth of the field, so do not try to keep the camera close to the authorization zone. On the other hand, the length of the focal length is small; the depth of the field is small. According to our procedure, the optimal distance from the camera to 6 to 10 meters. Although, it is impossible and not recognized from 100 meters away.

4.5 THREADING

Many lenses shatter the picture slightly. The most common is called the barrel decay of the film. Since the magnification centre is large and small on the edges, the resize of the object is caused. Therefore, if the same object falls on the centre of the film and its edge, its dimensions will appear smaller. This may affect the opportunity to identify. Low focal length and strong decay are noticeable. Therefore, it is unpleasant to use the cameras with White Angle lenses to identify (4mmm of 4mm).

Table.5: Comparison of Threading (in %)

Input	ALPR	ANPR	LPRNN	VNPR	FNPR
100	70.53	80.09	47.23	51.27	90.18
200	70.86	81.59	47.82	53.14	91.19
300	72.20	82.70	48.80	53.97	91.35
400	73.34	83.08	50.01	54.88	92.31
500	74.39	84.09	51.15	55.80	91.88
600	75.10	85.02	52.26	57.13	93.08
700	76.40	86.02	52.96	58.21	93.24

4.6 NOISE AND COLOUR REPRODUCTION

Low noise and very accurate colour reproduction, best to identify. Therefore, the minimum illumination of the camera is recommended to focus on the parameters such as the existence of noise reduction operations.

Table.6. Comparison of Noise and Colour Reproduction (in %)

Input	ALPR	ANPR	LPRNN	VNPR	FNPR
100	74.66	52.55	44.29	61.72	96.87
200	74.33	51.05	43.70	59.85	95.86
300	72.99	49.94	42.72	59.02	95.70
400	71.85	49.56	41.51	58.11	94.74
500	70.80	48.55	40.37	57.19	95.17
600	70.09	47.62	39.26	55.86	93.97
700	68.79	46.62	38.56	54.78	93.81

When the camera sensors are very loud, it is very important to suppress the noise in the low light, which complicates the identity. In many cases, you need to understand noise reduction and other electronic gadgets, and it is necessary to ensure sufficient levels of lights in the comfort.

4.7 VISUAL SUMMARY

Modern IP cameras send a shortened video signal, and if there is no movement in the frame or if it is less, the traffic will be small. If the movement in the law is serious, the traffic will grow. So, if the standard bitrates in the camera settings, the picture is ideal for identifying the lack of motion, but unused - with high movement in the law. To identify, the variable bitrates are recommended to be set up with the highest quality.

Table.7. Comparison of Visual Summary (in %)

Input	ALPR	ANPR	LPRNN	VNPR	FNPR
100	75.70	62.59	48.45	67.42	97.04
200	74.07	60.85	46.87	66.00	95.75
300	73.59	58.51	44.67	64.74	94.74
400	72.30	57.70	43.04	62.75	93.85
500	70.19	55.41	41.90	60.28	93.48
600	68.70	53.48	39.70	58.84	92.44
700	66.89	51.75	38.55	57.12	91.67

5. CONCLUSION

Generally, different methods are followed by the accidents and vehicles involved in criminal activities. It is the most important data type of the vehicle number blunt. This can be detected in various data of the variety, and the information of many parts in the vehicle will be stored in the Database. It is a very simple process to find the vehicle and its spare parts. The proposed FNPR was compared with the existing ALPR, ANPR, LPRNN and VNPR. The proposed method focused on and effectively identifies the number plate details while compared with the existing methods. This focused on the multi-parameter approach and provides the vehicle parts details, vehicle owner details and vehicle transportation details. The further enhancements of this method are to collect the penalty payments directly from the owner bank account using the Internet of Things (IoT). This will reduce the criminal activities while the vehicle was stolen.

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