Automatic License Number Plate Recognition Using Deep Learning

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Abstract— ***In this day and age, when there are more than 8 billion people on the planet and an equal amount of cars on the road, effective parking management has become essential. Vigilant gatekeeping is typically required in big residential areas because to the entry and egress of numerous vehicles, which can require significant labor and effort. In order to overcome these obstacles, the incorporation of Automatic License Plate Recognition (ANPR) is rather helpful. The approach that is being suggested entails creating an extensive database that holds car information for every member of a certain community. The Automatic Number Plate Recognition system, which has a camera placed strategically at the society's entrance gate, is smoothly linked to this database. The camera records a 10- to 12-second video as a vehicle approaches. This footage is then processed into images at a 24-frame-per-second (fps) rate utilizing sophisticated technologies like Matlab, Python, and several AI algorithms and search strategies. During this procedure, the image of the vehicle is carefully examined, which results in the number plate being extracted. Next, a cross-reference is made between this retrieved number and the previous database. When a match occurs, the gate opens automatically, allowing the car to enter the community.In addition, the system has the capability to record the times of entry and departure for every car, adding an extra degree of protection and streamlining monitoring. By limiting access to authorized vehicles exclusively, the implementation of an ANPR based system not only improves overall security but also streamlines the parking management process. Security staff now have a much lighter duty because they only haveto step in when a guest enters the society thanks to this innovation.***

KEY WORDS: Deep Learning, Convolutional Neural Network (CNN), Two-Dimensional Decomposition (2D-WD), Vertical Edges, Connected Components Analysis (CCA), Optical Character Recognition (OCR), Easy OCR.

I. INTRODUCTION

These days, the world's trend toward globalization demands constant technical development. Staying up with this trend means that technology needs to be updated frequently. The population of the world is growing at an accelerating rate, which causes a corresponding rise in the volume of vehicles on the roadways. A lot of work is required to park these cars in an efficient manner. The principal aim of the system's implementation is to provide an effective parking management and access control mechanism, thereby mitigating the obstacles related to parking. The first step of the system's operation is the input of a vehicle image, which is captured at four different levels .The input image is then preprocessed using a variety of tools, such as Matlab and a number of Python modules, libraries, and packages. The car's number is then recognized and extracted by the system. In order to determine access for the car, it lastly compares this extracted number with an already-existing database. If the number matches the database, admission to the specified society is made possible. On the other hand, access is refused if there is no match. Additionally useful in overseeing sizable events like parties and gatherings, this technique helps enforce social norms pertaining to discipline. It also offers thorough monitoring of vehicle entry and exit timings,

providing information on how cars are moving within the designated region.

II. LITERATURE REVIEW

This section describes the first step of the procedure, in which a vehicle enters the society and the camera records a 12- to 15-second video. The video is then submitted to video scanning. Next, MATLAB is used to transform the video to 24 frames per second (fps). A crucial part of the idea is turning the license plate of the car into an image. To identify the vehicle's license plate, sophisticated image processing methods such as segmentation, identification, and localization are used. By using the Canny Edge Detection Algorithm, the number plate's edges may be distinguished, which eventually helps with identification. All vehicle number plates in India follow the same format, regardless of whether they are for commercial or noncommercial vehicles. In the first two letters of the General Form, the District Code comes after the State [1].

Code, followed by the addition of a unique 4digit numerical code, a random alphabet sequence, and a numerical series.

"BHARAT," a new television series from India, is designed to make car transfers across states easier. This series' format consists of the current year (YY), "BHARAT" (BH), a 4-digit code (XXXX), and alphabets that are chosen at random (XX) [2].

When the colors of the license plate and the background are similar, there could be a problem when taking the picture. Technologies for character segmentation and image processing are necessary for number plate recognition. It takes a high-resolution camera to get a good picture of the license plate. The video capture, conversion to frames, choosing a clear image, and plate region processing based on characteristics like aspect ratio and edge density are the four fundamental phases. Subsequent segmentation is subsequently executed to discern every digit and alphabet present on the number plate.

Despite the system's efficacy, certain drawbacks are identified. The fixed camera records a 12-15 second video, which is processed using Matlab to yield 240 frames per image. Specific techniques are applied to extract the license plate from these images. Several resolution methods, including Image Restoration and Contrast Enhancement, are employed to enhance the clarity of the retrieved images for effective number plate identification.

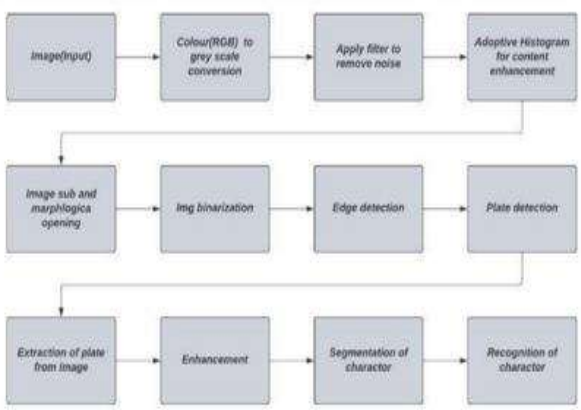
During the digitization process of images, various noise kinds, including poison noise, salt noise, and pepper noise, are encountered. To deal with these noises, several filtration methods are used, such as BM3D (Block Machine), Gaussian-guided, Minmax, Linear, Median, and Wiener. Experiments reveal that no single filter is superior to the others; however, BM3D is shown to be stable and all-encompassing. While linear filters are used to get rid of harmful noises, median filters are good at removing noises like salt and pepper. Adaptive fuzzy median filters work well in difficult situations to reduce noise from salt and pepper [3].

This study concentrates on identifying license plates in images that are well-lit and poorly-lit, although it advises against utilizing images that are noisy, fuzzy, or have low contrast. The procedure for recognizing license plates in photos with and without light is shown in the flowchart. Using Raspberry Pi and Matlab procedures, the paper

Plate edges	Detect edge of number plate
Character Analysis	To find charactor
Deskew	To transform size
OCR	Number plate recognition
Detection	To detect number plate
Binarization	To convert grey scale to binary
Post processing	To process the number
Character segmentation	To segment number

Fig 2.1

implements "ANPR" with an emphasis on parking premises security. Getting an image is the first step, which depends on having a steady and balanced image. When a car approaches, the sensor network's TSOP 1738 sensor detects it, prompting the Raspberry Pi camera to take pictures. Next are image processing chores like grayscale conversion and cropping the desired region. Dilation techniques are used to improve edges and lessen color disparities. The plate localization is which get over morphological processing's drawbacks. The execution of a neural network with feedforward backpropagation demonstrates a processing time of 1.3 seconds in a dynamic environment, and effectively accomplishes plate detection, localization, and character detection [4].



Block diagram of proposed system

Fig 2.2

To capture license plate numbers at parking gates, Automatic Number Plate Recognition (ANPR) is used to monitor and regulate entry in both public and private organizations. The identification of stolen cars on the road is another application for this technique. At entrances and exits, cameras are positioned strategically, and the photos they take are strategically, and the photos they take are processed on computers and kept in a database for a long time. The system makes parking gates open and close automatically, and it needs highend, weatherproof, and dustproof cameras that can handle a range of weather conditions. It demonstrates its affordability by analyzing photos in any condition range and identifying cars on both the white- and black-lists, prohibiting unwanted access and guaranteeing security.

III.PROPOSED SYSTEM

Automatic License Plate Recognition (ALPR) is a system that uses image processing technology to identify and read license plate numbers on vehicles. To effectively recognize license plates, it is important to perform several preprocessing steps to ensure the images are in the correct format and are of high quality.

Hence, data preprocessing is an important step in ALPR to ensure accurate and efficient recognition of license plates. By applying the appropriate techniques for image acquisition, enhancement, plate localization, character segmentation, and character recognition, ALPR systems can achieve high accuracy rates and perform effectively in a variety of settings.

3.1.1 Dataset Description

The dataset was taken from the Kaggle repository which contain 273 images out of which 248 belongs to train category and 25 are test category images. All the images are of jpeg format.

3.1.2 Splitting the Set of data

The first step in splitting a dataset [5] is to prepare the data. This includes cleaning the data, removing any duplicates or outliers, and encoding categorical variables. The data should also be normalized or standardized if necessary.

Once the data has been prepared, the next step is to split the dataset into training, validation, and test sets.

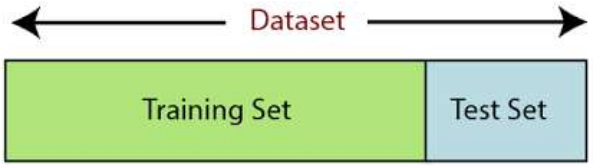


Fig 3.1

3.2 License Plate Detection and Recognition

The system technology uses a combination of image processing and computer vision algorithms to detect and recognize the characters on a license plate.

3.2.1 License Plate Detection

The first stage is to detect the license plate in an image or video stream. This is achieved using morphological operations to identify the region of interest (ROI). Once the ROI is identified, it can be cropped and passed on to the next stage of the LPDR process [6].

Fig 3.2

3.2.2 Two Dimensional Wavelet Decomposition

2D-WD is a technique used in signal processing and image analysis to decompose a two-dimensional signal or image into different frequency bands. The technique involves decomposing the signal into different scales and orientations using a series of filters, each of which extracts information at a particular frequency and direction.Scharr filters, to compute the gradient magnitude of the image in the vertical direction. The resulting gradient magnitude image can then be thresholded to identify regions with a high density of vertical edges [7].

To obtain a more robust extraction, additional processing steps can be performed. Connected component analysis can be used to group nearby edge segments into regions, which can then be filtered based on their size and shape.

3.2.3 High Vertical Edge Density Extraction

The basic idea behind high vertical edge density extraction is to use a set of filters that are sensitive to vertical edges, such as the Sobel, Prewitt, or the image in the vertical direction. The resulting gradient magnitude image can then be threshold to identify regions with a high density of vertical edges.

To obtain a more robust extraction, additional processing steps can be performed. Connected component analysis can be used to group nearby edge segments into regions, which can then be filtered based on their size and shape.

3.2.4 Localization and Segmentation

License plate localization is the process of identifying and localizing license plates in an image or video frame. The goal is to accurately detect the location of the license plate within the image or video frame so that it can be processed for further tasks such as character recognition.

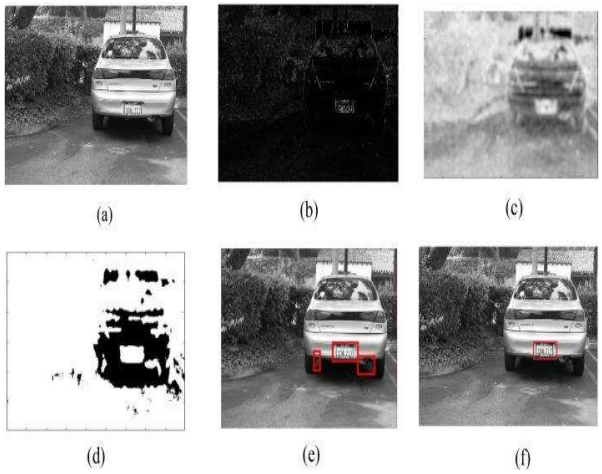


Fig 3.3

License plate segmentation is the process of separating the characters or digits of a license plate from the background in an image or video frame. The goal is to accurately segment the characters of the license plate so that they can be recognized and processed for further tasks such as character recognition.

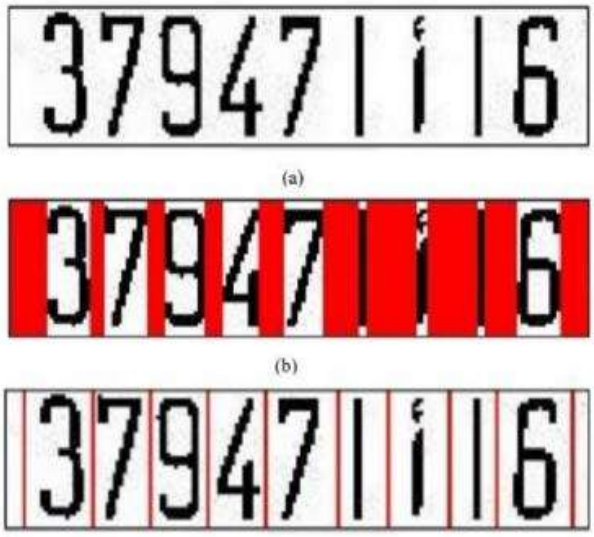


Fig 3.4

IV.RESULT ANALYSIS

4.1 Result Analysis

The model analysis of this system involves assessing the underlying algorithms and techniques used to capture and recognize license plate numbers. The model is trained for 25 to 32 epochs with 10 to 15 batches and validated each epoch using loss and accuracy The system has shown to have high accuracy rates, ,fast processing speed, high throughput, and robust performance in various environmental conditions that can quickly and accurately read and process the license plate numbers in real-time.

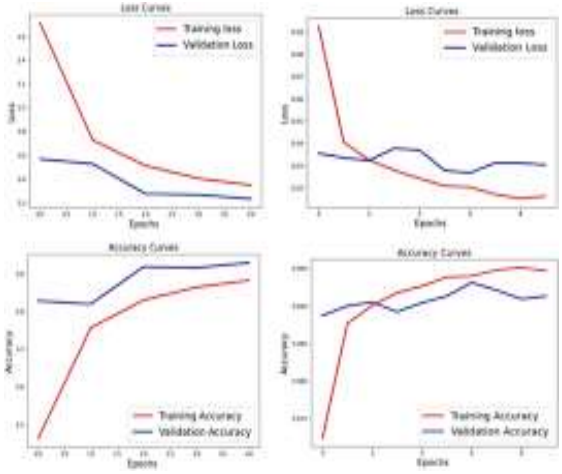


Fig 4.1

Furthermore, It has been improved in security and privacy features, such as data encryption, access control, and data retention policies, which help to protect the privacy of individuals whose license plates are being recorded and prevent unauthorized access to the data.

With the continued advancement of technology, it is likely that the system will become even more accurate and efficient, making them an even more valuable tool.

V. CONCLUSION

Every company in the modern world aspires to adopt the newest technologies, a need made even more pressing by the difficulties presented by the most recent worldwide epidemic. There is a constant need for innovation in the field of parking and traffic management systems. The increase in automobile traffic has made effective parking management essential. As a result, we have concentrated on investigating Automatic License Number Plate Detection using Deep Learning.

Gatekeepers must exert significant effort to manually handle the main gate in large housing societies, where thousands of vehicles constantly enter and exit. With the use of Automatic Number Plate Recognition (ANPR), which automates gate access by scanning and recognizing vehicle numbers, this procedure is made much simpler and less demanding on watchmen.

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