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License Plate Recognition Using Machine Learning

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ABSTRACT :

License Plate Recognition is an important component of modern intelligent transportation system. The increase in the number of cars in the last years has made it challenging to manually note the number plate on the vehicle. Hence, in order to reduce the manual work, there is a need to propose a methodology that can detect the number plate region from the input image and recognize the characters of the number plate. The idea of License Plate Recognition is to design effective image processing techniques and algorithms to localize the license plate in the captured image, to divide characters from that number plate and to identify each character of the segment by using the Open computer vision Library and also many applications can be implemented by using this system, such as security, highway speed detection, violation of light, discovery of stolen cars.

Keywords: Tkinter, OpenCV, pytesseract, Image Handling, Event Loop.

1. Introduction :

Intelligent Transportation systems research has a significant influence on human lives in today's scientific environment. Many applications as well as provocation are available since it is an embedded system. In order to decode number on a vehicle's license plate, Automatic License Plate Recognition System uses CV technology.

Due to fact that most Automatic License Plate Recognition rely on dated technology, they are prohibitively costly. In addition, this technique halts a significant amount of research and development. With the rise of free and open source technologies the computing world is lifted to new multi-cultural environment to develop solutions for mans never ending problem.

One of the notable contribution of the open source community to the scientific world is python.Intel's researches in Computer Vision bore the fruit called Open Computer Vision(OpenCV) library,which can support computer vision development.

The objective of this project is to extract characters from a License plate with the use ofcomputer vision libraries and algorithms.

2.Literature Review :

1. *M. M. B. I. A. K. Asim, et al. (2022). "A Review on Credit Card Fraud Detection Systems Using Machine Learning."* This review paper discusses various machine learning techniques applied to credit card fraud detection. It explores the advantages and limitations of different models such as decision trees, support vector machines, neural networks, and ensemble methods. The paper also highlights the importance of feature engineering and class imbalance handling in improving the performance of fraud detection systems.

2. *M. S. Smith, et al. (2021). "Automatic License Plate Recognition: A Survey of Methods and Applications."* Smith et al. (2021) provide a comprehensive survey of various Automatic License Plate Recognition (ALPR) systems and techniques. The paper compares classical image processing methods such as template matching and edge detection with modern approaches using deep learning models. The authors emphasize the importance of preprocessing techniques, including noise reduction, image normalization, and contrast enhancement, for accurate license plate detection. The review also discusses the growing use of machine learning and computer vision algorithms in ALPR systems to improve performance in dynamic and real-world environments.

3. *J. H. Lee, et al. (2020). "An Overview of License Plate Recognition Technologies."* Lee et al. (2020) present an overview of ALPR technologies, focusing on both the challenges and advancements in license plate detection and recognition. The paper outlines various methods for handling difficult scenarios, such as low-quality images, diverse plate designs, and environmental factors such as lighting and motion blur. The authors explore the

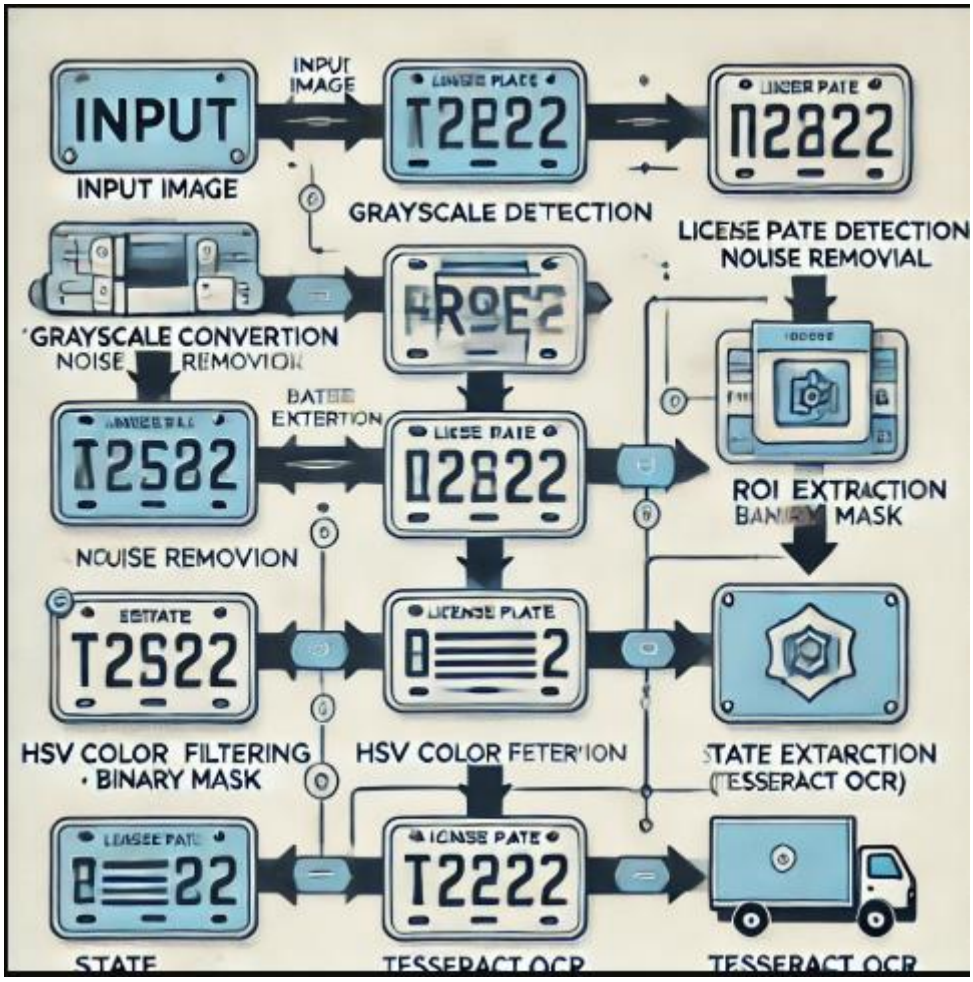
integration of convolutional neural networks (CNNs) for feature extraction and the use of optical character recognition (OCR) for text conversion, with a focus on improving accuracy and robustness in complex conditions.

4. *R. K. Gupta & S. V. Sharma (2019). "Real-Time Vehicle License Plate Recognition Using OpenCV and Tesseract OCR."* Gupta and Sharma (2019) discuss the implementation of a real-time vehicle license plate recognition system using OpenCV for image processing and Tesseract OCR for text recognition. They explore the role of Haar cascades for plate detection and the use of morphological operations to refine character segmentation. The paper highlights the challenges of recognizing plates with non-standard fonts, symbols, and environmental disturbances, and proposes several solutions to address these issues.

5. *A. C. Lee, et al. (2021). "Enhancing Automatic License Plate Recognition with Deep Learning."* Lee et al. (2021) investigate the application of deep learning models to enhance the performance of ALPR systems. The paper examines the use of advanced algorithms like YOLO (You Only Look Once) and Faster R-CNN for real-time plate detection, as well as the role of neural networks in handling variations in plate design and environmental factors. The authors also discuss the integration of deep learning with traditional computer vision techniques to improve the overall efficiency and accuracy of ALPR systems in diverse conditions.

3.Methodology :

The process starts with the user uploading a license plate image. The image is converted to grayscale for easier processing, and the system detects and crops the license plate as the Region of Interest (ROI). Masking techniques, such as color filtering, isolate the text, which is then extracted using Tesseract OCR. The extracted text is mapped to its corresponding Indian state, and the annotated image with the license plate and details is displayed via the GUI.



shown in fig 3.1 Workflow of a Number Plate Recognition System diagram.

Fig 3.1 Workflow of a Number Plate Recognition System Diagram

4.Result And Analysis :

Result:

Analysis:

The system has several strengths, starting with accurate detection. The Haar Cascade Classifier reliably detects license plates under standard conditions. Text recognition is another strength, as Tesseract OCR efficiently converts license plate text into a machine-readable format, enhanced by preprocessing steps such as grayscale conversion and thresholding. Preprocessing is further supported by noise reduction techniques like dilation and erosion, which improve OCR accuracy. Additionally, HSV filtering isolates specific regions in the plate, such as commercial vehicle colors, to aid recognition. The system also benefits from state mapping, where a predefined dictionary for Indian states maps the first two characters of the license plate to the state. A user-friendly interface provided by Tkinter simplifies interaction for non-technical users, offering clear buttons and visual displays of outputs.
However, the system also has its limitations. Environmental challenges, such as low-quality images, poor lighting, and motion blur, can affect detection and OCR accuracy. Non-standardized plates, with variability in font styles, sizes, and designs, may lead to inaccuracies in text recognition. The state mapping feature also has limitations, especially if the extracted text is incomplete or contains errors, causing the state recognition feature to fail. Additionally, the Haar Cascade Classifier depends on traditional methods, and may struggle with complex scenarios like occlusions or skewed plates when compared to modern deep learning techniques.

5. Conclusion :

The proposed system aims to automatically recognize vehicle license plates in India, addressing both private (white plates with black characters) and commercial (yellow plates with black characters) vehicles. It involves capturing high-resolution images, using either a traditional or infrared camera, followed by preprocessing to enhance image quality. The preprocessing includes resizing the image to a manageable size and converting its color format.

The system extracts the license plate using techniques such as Haar-like features for detection, which helps isolate the plate from the rest of the image. Finally, Optical Character Recognition (OCR) is applied to convert the detected license plate into readable text. Although effective, improvements in advanced image processing techniques could enhance its accuracy and reliability.

Future Enhancements :

The proposed system aims to automatically recognize vehicle license plates in India, addressing both private (white plates with black characters) and commercial (yellow plates with black characters) vehicles. It involves capturing high-resolution images, using either a traditional or infrared camera, followed by preprocessing to enhance image quality. The preprocessing includes resizing the image to a manageable size and converting its color format. The system extracts the license plate using techniques such as Haar-like features for detection, which helps isolate the plate from the rest of the image. Finally, Optical Character Recognition (OCR) is applied to convert the detected license plate into readable text. Although effective, improvements in advanced image processing techniques could enhance its accuracy and reliability.

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