LICENSE PLATE DETECTION USING MACHINE LEARNING

Purusothaman N K, Rithik Kannan V, Harish T

Purusothaman N K, Computer Technology, Bannari Amman Institute of Technology, Tamil Nadu, India
Rithik Kannan V, Computer Technology, Bannari Amman Institute of Technology, Tamil Nadu, India
Harish T, Information Science and Engineering, Bannari Amman Institute of Technology, Tamil Nadu, India

ABSTRACT

A crucial technology with many applications in traffic management, security, and law enforcement is license plate detection utilizing machine learning. In this abstract, a machine learning-based method for precisely locating and identifying license plates in pictures and video streams is presented. Data gathering, preprocessing, object detection using deep learning methods like YOLO, license plate recognition using optical character recognition (OCR), and post-processing to improve findings are all part of the mPlate Detection, OpenCV module, OCR Technology.ethodology. Metrics including precision, recall, F1-score, are used to assess performance. The system offers enormous promise for improving efficiency and safety in numerous sectors when it is implemented in real-world circumstances, whether on edge devices or in the cloud. This abstract emphasizes how important machine learning is for automating difficult processes, solving real-world problems, and improving CV. The trained model can also be used in a variety of applications, including security systems, toll booth monitoring, parking enforcement, traffic management systems, and parking enforcement. The system can be implemented on edge devices for real-time processing or in the cloud for scalability depending on the individual requirements of the application.

Keyword: -

1. INTRODUCTION

The need for autonomous traffic systems: The growing number of vehicles on the road in modern cities makes it necessary to build a reliable autonomous traffic system for better traffic law enforcement.

The identification of automobiles by their license plates is one of the system's essential components, and it plays a key role in that identification. When taking digital photos, whether in color, grayscale, or even infrared, number plate recognition is the method utilized to extract license plate images.

The Number Plate Recognition system makes use of a variety of approaches and algorithms. These consist of image pre-processing to improve the quality of the image, object detection to find the license plate in the image, character segmentation to distinguish between the different characters on the plate, and character recognition to read and recognize the characters themselves. It typically has a camera that can record and identify license plates.

Intelligent Transportation Systems (ITSs) are crucial. Intelligent Transportation Systems (ITSs) are receiving more attention as a result of the expansion of highways and the extensive usage of automobiles. The goal of these technologies is to improve traffic management, particularly traffic law enforcement.

1.1 Enhancing Security and law Enforcement

The main reasons for developing license plate recognition technology are to increase security and aid law enforcement. As cities get more populated and there are more cars on the road, protecting the public and keeping an eye on criminal activity are top priorities. Law enforcement organizations are given a potent tool by accurate and effective license plate detection to locate and follow stolen automobiles. Investigate and clear up vehicle-related offenses.

1.2 Streamlining and Traffic Management and Parking Solution

Effective traffic management is now urgently needed as traffic congestion in metropolitan areas worsens. License plate recognition is crucial in this situation since it enables the identification of traffic congestion and real-time traffic flow analysis. Decreasing traffic jams and automating toll collecting.

Due to urbanization and a lack of parking infrastructure, demand for intelligent parking solutions has increased. Using license plate recognition helps with automating entrance and departure procedures for parking. enabling accurate computation and payment of parking fees.

2. OBJECTIVES OF THE PROPOSED WORK:

The main goals of the proposed work in the area of license plate recognition are to advance technology and meet particular needs and obstacles. These goals act as principles for the work on research and development:

Improve Accuracy and Robustness: To ensure dependable performance under a variety of conditions, such as changes in illumination, plate design, and image quality, license plate detection algorithms must be made more accurate and robust.

Real-Time Processing: Create or improve algorithms and hardware setups to enable real-time processing, which enables instantaneous license plate identification, which is essential for applications like traffic control and security.The main goals of the proposed work in the area of license plate recognition are to advance technology and meet particular needs and obstacles. These goals act as a set of guiding principles.

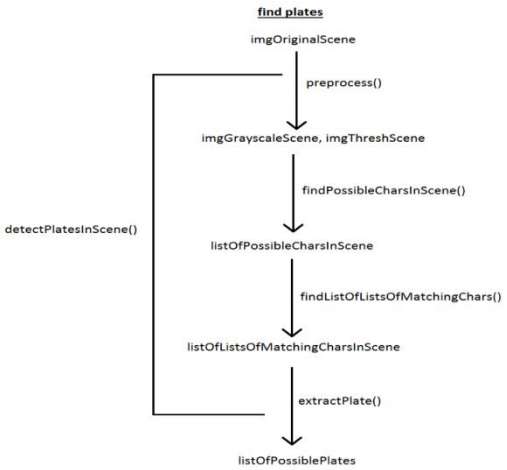

Fig -1: Flow diagram of the proposed work

2.1 Creating a synthetic procedure for a proposed work involves:

- Defining the goals.
- A list of the tools and materials.
- Including security measures.
- Describing the steps in detail.
- Addressing the gathering and evaluation of data.
- Quality assurance and troubleshooting are included.
- Creating a process record.
- Preparing to finish and report.
- Ensuring evaluation and, if necessary, approval.
- Defining the outcome or result.
- Creating a timeline with checkpoints.

2.3 MACHINE LEARNING-BASED APPROACHES:

License plate recognition underwent a dramatic change with the introduction of machine learning. To increase detection accuracy, researchers started using supervised learning methods like Support Vector Machines (SVMs). These methods demonstrated promise in managing differences in plate appearance, but they remained constrained in challenging situations.

3. PROPOSED WORK MODULES:

The proposed task entails creating a real-time, accurate license plate identification system based on machine learning. This system attempts to improve the accuracy and effectiveness of recognizing license plates in a variety of settings and scenarios by utilizing cutting-edge algorithms and training data. The main goals are to increase precision, accelerate processing, and guarantee flexibility to real-world situations, which will boost automation, traffic management, and security applications.

3.1 VISION ENHANCEMENT:

The term "vision enhancement" describes methods and algorithms that enhance the sharpness, clarity, and visibility of license plate images. By improving the input photos before processing, these techniques, which frequently involve image preprocessing, seek to improve the precision and dependability of the license plate detection system.

3.2 Control and Decision-making optimization:

Database collection is the initial step in the number plate detection process. This database was gathered from Kaggle.com, one of the most well-known and reliable websites with a wide range of datasets.
The number plates of various cars from various states with a wide range of registration numbers are included in the dataset that was acquired.
Utilizing the dataset downloaded from Kaggle, the following step entails data preprocessing.
In order to prepare our data, we take the following actions:

- Cleaning up data
- Rearrange our data so that it reflects pixel density.
- Data segmentation for training and testing.
- Produce sample inputs.
- Develop training and test set output targets.

- Create .png files from the prepared data.

After acquiring a dataset and applying data preparation methods to it, the following phase entails implementation.

3.3TESTING AND EVALUATION (TESTING PHASE):

Conduct a thorough testing and evaluation process to fully assess a machine learning-based license plate detection system. This process should involve data splitting for training, validation, and testing, the use of accuracy metrics, the establishment of a baseline model, the implementation of cross-validation for robustness, testing under various conditions and scenarios, the analysis of false positives and negatives, an evaluation of speed and efficiency, the assurance of hardware scalability, and real-world testing. This thorough approach allows for ongoing improvement while guaranteeing the system's accuracy, robustness, and ethical compliance in real-world applications

3.4 METHODOLOGY OF THE PROPOSED WORK:

Database collection is the initial step in the number plate detection process. This database was gathered from Kaggle.com, one of the most well-known and reliable websites with a wide range of datasets.

The number plates of various cars from various states with a wide range of registration numbers are included in the dataset that was acquired.

Utilizing the dataset downloaded from Kaggle, the following step entails data preprocessing.

In order to prepare our data, we take the following actions:

- Cleaning up data
- Rearrange our data so that it reflects pixel density.
- Data segmentation for training and testing.
- Produce sample inputs.
- Develop training and test set output targets.
- Create .png files from the prepared data.

After acquiring a dataset and applying data preparation methods to it, the following phase entails implementation.

3.5. RECOGNITION:

EasyOCR is a Python package for optical character recognition (OCR), which can be useful for machine learning-based license plate detection. Even though EasyOCR isn't a license plate recognition library in and of itself, it can be a useful part of one.The characters on the license plate can be extracted and recognized using EasyOCR when a license plate region has been identified in an image or video frame.It offers a simple method for transforming the textual data on the license plate into a machine-readable format.EasyOCR can be used as a post-processing step to check and adjust the identified characters from license plates.By confirming that the characters taken from the detected location are legitimate license plate characters, it can assist in removing false positives.EasyOCR is appropriate for real-time or near-real-time applications like license plate identification systems since it is made with efficiency in mind and can swiftly extract text from photos.License plates occasionally contain specific characters or symbols that are not included in the OCR libraries.

Custom character sets can be defined with EasyOCR to ensure accurate recognition of uncommon characters.

3.6. CONFIDENCE SCORES:

1. To show how confident the OCR algorithm is in character recognition, EasyOCR provides confidence scores for each identified character.

2.The accuracy of the system can be improved by using these confidence scores to establish criteria for accepting or rejecting character recognition results.

3.EasyOCR can be used to process the region and extract characters after the license plate region has been identified.

3.7. RISK ASSESSMENT:

Data Privacy and Legal Compliance

Risk: Processing and collecting license plate information could result in issues with privacy and the law. Legal repercussions may result from breaking data protection laws.

Making sure that data gathering and storage abide by applicable privacy rules is a mitigation measure. Obtain the relevant consents, anonymize the data if necessary, and put stringent access controls in place.

Implementing strong security measures to prevent cyberattacks, testing and adapting the system for different environmental conditions, addressing hardware and software failures through redundancy and

maintenance, mitigating biases and ethical concerns in data and algorithms, and ensuring data privacy and compliance with relevant regulations are all necessary components of effective risk management for license plate detection.

3.8. TESTING METHODS:

Validation Set: To fine-tune model hyperparameters and track the status of training, use a piece of your dataset (for example, 10-15%) as a validation set. This makes it more likely that the model will generalize effectively to new data.

Test Set: Set aside an additional chunk of your dataset (for example, 10–15%) as a test set. This collection is used to assess the model's effectiveness following training. It gives an indication of how accurately the algorithm can identify license plates on fresh, undiscovered photos. Field testing entails setting up the system in actual usage areas, such as parking lots, toll booths, or security checkpoints. Keep an eye on how it performs in various weather, traffic, and lighting settings.

Traffic Data: Gather information from urban traffic cameras or sensors to assess the system's precision in real-time traffic situations.

Accuracy Metrics:

Calculate the overlap between the ground truth boxes and the detected bounding boxes using the intersection over union (IoU) method. IoU is a widely used statistic to evaluate the spatial precision of detection.Measure the trade-off between detection accuracy and completeness by computing precision (true positives / true positives + false positives) and recall (true positives / true positives + false negatives).The harmonic mean of recall and precision makes up the F1-score, which offers a statistic that balances the two.

Robustness Testing:

Test the detection system in diverse environments, such as those with variable lighting conditions (day, night, shadows), weather conditions (rain, snow, fog), and views (elevated, oblique angles).

4. CONCLUSIONS:

Using machine learning algorithms like CNN for car number plate recognition is effective, especially with high-quality cameras, as low-quality cameras can reduce accuracy. License plate recognition offers advantages in security, traffic management, and automation, benefiting various industries. However, challenges such as data privacy, regulatory compliance, resource needs, and ethical considerations must be addressed for responsible implementation.

5. REFERENCES:

Rahul R. Palekar, Sushant U. Parab, Dhrumil P. Parikh, Vijaya N. Kamble, "Real Time License Plate Detection Using OpenCV and Tesseract", International Conference on Communication and Signal Processing, April 6-8, 2017, India.

Hung Ngoc Do, Minh-Thanh Vo, Bao Quoc Vuong, Huy Thanh Pham, An Hoang Nguyen, and Huy Quoc Luong, "Automatic License Plate Recognition Using Mobile Device", School of Electrical Engineering International University, Vietnam National University.

Pratiksha Jain, Neha Chopra, Vaishali Gupta, "Automatic License Plate Recognition using OpenCV", International Journal of Computer Applications Technology and Research Volume 3– Issue 12, 756 - 761, 2014, ISSN: - 2319–8656.

Tella Pavani, DVR Mohan, "Number Plate Recognition by using open CV- Python", International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 06 Issue: 03.