ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
pp. 108-118

Article Title: **YOLO Based License Plate Detection of Violators**

YOLO Based License Plate Detection of Violators

T. V. Ananda Babu[1], B. Pavithra[2], K. Naveen[3], B. Pavan[4], C. Shanmukh[5], D. Chiranjeevi[6]

[1]Assistant Professor, Department of Electronics and Communication Engineering, Sri Venkatesa Perumal College of Engineering and Technology, Puttur, AP, India

[2,3,4,5,6]UG Students, Department of Electronics and Communication Engineering, Sri Venkatesa Perumal College of Engineering and Technology, Puttur, AP, India.

ABSTRACT

Road safety is of prime importance, as road accidents are among the biggest cause number of death in the country. Road accidents are primarily due to violators and lawbreakers of road safety rules like not wearing helmets, triple riding, etc. Even though there are many smart systems to monitor these violations, it is complicated to keep track of the data and view it efficiently from anywhere. Also, monitoring the permit details of other state vehicles is hard. A method was proposed to address this issue based on deep learning and optical character recognition (OCR). Here, we detect the riders not wearing helmets and triple riders using object detection by comparing YOLO versions. This simplifies the task of traffic police, who can't continuously and efficiently monitor all the violators. A number of items can be recognized by the real-time object recognition system YOLO in a single frame. It recognizes objects more precisely and faster than other recognition systems. It can predict up to 9,000 classes and even unseen classes. For number plate detection, we use OCR-based character recognition. The recognized license plate images of violators are captured and stored in a database, which is then sent to the concerned department.

Keywords: Deep Learning, Object Detection, YOLOv3, Convolution Neural Network.

1. Introduction

In the modern era of advancing technology, ensuring law enforcement's efficacy and public safety requires innovative solutions. Among the myriad challenges faced by authorities, the detection of traffic violators stands prominent. Violations such as speeding, reckless driving, and disobeying traffic signals not only endanger lives but also undermine the integrity of road regulations.

One pivotal aspect of traffic enforcement is the identification and documentation of vehicles through their license plates. Traditional methods, reliant on manual intervention, are time-consuming, prone to errors, and often insufficient in coping with the escalating demands of urban traffic management. However, with the advent of deep learning and computer vision techniques, a paradigm shift has occurred in automating the process of license plate detection.

ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
pp. 108-118

Article Title: YOLO Based License Plate Detection of Violators

In this context, the You Only Look Once (YOLO) algorithm emerges as a beacon of technological prowess. Renowned for its real-time object detection capabilities, YOLO revolutionizes license plate detection by providing swift and accurate identification of vehicles, thereby facilitating law enforcement agencies in their mission to maintain road safety and uphold traffic regulations.

The essence of YOLO lies in its ability to process images swiftly and detect objects, including license plates, in a single pass through a neural network. This efficiency is particularly crucial in scenarios where real-time monitoring and instant response are imperative, such as identifying traffic violators on highways or monitoring congested urban intersections.

Furthermore, the YOLO-based license plate detection system transcends conventional constraints by its adaptability to varying environmental conditions. Be it daytime, night time, or adverse weather conditions, YOLO exhibits robustness in detecting license plates with commendable accuracy, minimizing false positives, and enhancing the reliability of enforcement actions.

Moreover, the integration of YOLO with auxiliary technologies such as optical character recognition (OCR) further enhances its capabilities. By deciphering the alphanumeric characters on license plates, OCR complements YOLO's detection prowess, enabling seamless retrieval of vehicle registration information, thereby expediting the process of issuing citations and ensuring accountability.

In essence, the YOLO-based license plate detection system represents a paradigm shift in traffic enforcement, offering unprecedented speed, accuracy, and adaptability. By leveraging the power of deep learning and computer vision, this technological marvel empowers law enforcement agencies to combat traffic violations effectively, fostering safer roads and vibrant communities.

In the subsequent sections of this discourse, we delve deeper into the intricacies of YOLO-based license plate detection, exploring its underlying mechanisms, implementation challenges, and real-world applications. Through empirical analysis and case studies, we unravel the transformative impact of this cutting-edge technology in reshaping the landscape of traffic enforcement and bolstering public safety.

2. Recent Work

1. Paridhi Swaroop, Neelam Sharma, “An Overview of Various Template Matching Methodologies in Image Processing”, International Journal of Computer Applications (0975 – 8887) Volume 153 – No 10, November 2016. The following paper gives a comparison about applications and methods where template matching is used. Template is primarily a sub-part of an object that is to be matched amongst entirely different objects. The techniques of template matching are flexible and generally easy to make use of, that makes it one amongst the most famous strategies of object localization. Template matching is carried out in versatile fields like image processing, signal processing, video compression and pattern recognition. The following template matching techniques are used Naive

Template Matching, Image Correlation Matching, Sum of Absolute Difference, sum of square difference.

2. Lucky Kodwani & Sukadev Meher "Automatic License Plate Recognition in Real Time Videos using Visual Surveillance Techniques "ISSN (PRINT): 2320 – 8945, Volume -1, Issue -6, 2013. This paper presents full-featured vehicle detection, tracking and license plate recognition system. It consists of vehicle detection, license plate extraction and a character recognition module. Here, first foreground estimation is done by Gaussian mixture model, then a real time and robust method of license plate extraction based on block variance technique is proposed. License plate extraction is an important stage in license plate recognition for automated transport system. The extracted license plates are segmented into individual characters by using a region-based approach. The recognition scheme combines adaptive iterative thresholding with a template matching algorithm.

3. Riazul Islam, Kazi Fatima Sharif and Satyen Biswas, "Automatic Vehicle Number Plate Recognition Using Structured Elements", IEEE Conference on Systems, Process and Control December 2015, pp 44-48. This research presents a prosperous method to identify vehicle number plates. The proposed technique is built on morphological operations based on different structuring elements in order to maximally exclude non-interested region and improve object area. This system has been experienced using a database of number plates and simulated results demonstrate major improvements as compared to other conventional systems.

4. Muhammad Tahir Qadri, Muhammad Asif "Automatic Number Plate Recognition System for Vehicle Identification using Optical Character Recognition" IEEE 2009. The objective is to design an efficient automatic authorized vehicle identification system by using the vehicle number plate. The system is implemented on the entrance for security control of a highly restricted area like military zones or area around top government offices e.g. Parliament, Supreme Court etc. The developed system first detects the vehicle and then captures the vehicle image. Vehicle number plate region is extracted using the image segmentation in an image. Optical character recognition technique is used for the character recognition. The resulting data is then used to compare with the records on a database so as to come up with the specific information like the vehicle's owner, place of registration, address, etc.

5. Aniruddh Puranic, Deepak K. T, Umadevi V "Vehicle Number Plate Recognition System: A Literature Review and Implementation using Template Matching" International Journal of Computer Applications (0975 – 8887) Volume 134 – No.1, January 2016. The growing affluence of urban India has made the ownership of vehicles a necessity. This has resulted in an unexpected civic problem - that of traffic control and vehicle identification. The Automatic Number Plate Recognition System (ANPR) plays an important role in addressing these issues as its application ranges from parking admission to monitoring urban traffic and to tracking automobile thefts. There

are numerous ANPR systems available today which are based on different methodologies. In this paper, we attempt to review the various techniques and their usage. The ANPR system has been implemented using template Matching and its accuracy was found to be 80.8% for Indian number plates

6. Byung-Gil Han, Jong Taek Lee, Kil-Taek Lim, and Yunsu Chung "Real-Time License Plate Detection in High Resolution Videos Using Fastest Available Cascade Classifier and Core Patterns" ETRI Journal, Volume 37, Number 2, April 2015. We present a novel method for real-time automatic license plate detection in high resolution videos. Although there have been extensive studies of license plate detection since the 1970s, the suggested approaches resulting from such studies have difficulties in processing high-resolution imagery in real-time. Herein, we propose a novel cascade structure, the fastest classifier available, by rejecting false positives most efficiently. Furthermore, we train the classifier using the core patterns of various types of license plates, improving both the computation load and the accuracy of license plate detection. To show its superiority, our approach is compared with other state-of-the-art approaches. In addition, we collected 20,000 images including license plates from real traffic scenes for comprehensive experiments. The results show that our proposed approach significantly reduces the computational load in comparison to the other state-of the-art approaches, with comparable performance accuracy.

7. Nighat Naaz Ansari, Ajay Kumar Singh "License Number Plate Recognition using Template Matching" International Journal of Computer Trends and Technology (IJCTT) – Volume 35 Number 4- May 2016. In this paper, recognition of characters written on a vehicle license number plate is proposed. Method used that is for the recognition of the characters from the license number plate and is based on template-matching. In this method, first the image of a car license number plate is taken as input, then pre-processing steps such as conversion to Gray-scale image, dilation, erosion, convolution is done to remove noise from the input image. Then each character in the number plate is segmented. Segmentation is done on the basis of connected components. Then after segmentation, recognition of characters is done by matching templates to the segmented characters. Matching is done on the basis of correlation between segmented characters and the templates in the database. In the last step, a text file shows the recognized number and the character from the input image.

8. M. M. Shidore, S. P. Narote," Number Plate Recognition for Indian Vehicles" IJCSNS International Journal of Computer Science and Network Security, Vol.11 No.2, Feb. 2011. An algorithm for vehicle number plate extraction, character segmentation and recognition is presented. Database of the image consists of images with different size, background, illumination, camera angle, distance etc. The experimental results show that, number plates are extracted faithfully

ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
pp. 108-118

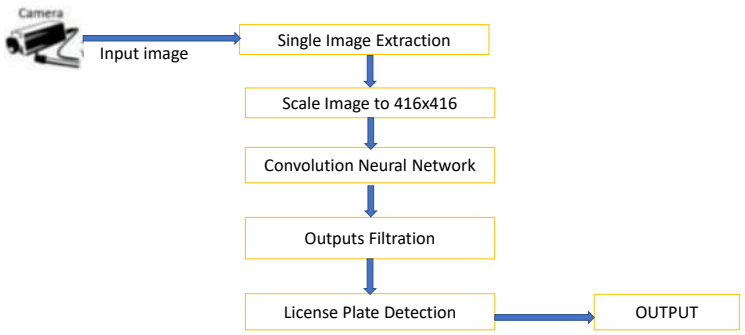
Article Title: YOLO Based License Plate Detection of Violators

based on vertical edge detection and connected component algorithm, with the success rate of 85%. Character segmentation phase using connected component analysis and vertical projection analysis works well with the success rate of 80%. The success rate achieved for character recognition is 79.84%

3. Existing System

The car plates appear in different types of character styles, either single or double row, different sizes, spacing and character counts. Due to such kind of variations even localizing or detecting these plates becomes a tedious process. In the existing system, foreground estimation is done by Gaussian mixture model then proposing a real time and robust method of license plate extraction based on block variance technique. License plate extraction is an important stage in license plate recognition for automated transport system. The Extracted license plates are segmented into individual characters by using a region based approach. The recognition scheme combines adaptive iterative thresholding with a template matching algorithm.

EXISTING PROJECT BLOCK DIAGRAM



First, it is necessary to locate and extract the license plate region from a larger scene image. Second, having a license plate region to work with, the alphanumeric characters in the plate need to be extracted from the background. Third, deliver them to an OCR system for recognition. In order to identify a vehicle by reading its license plate successfully, it is obviously necessary to locate the plate in the scene image provided by some acquisition system (e.g. video or still camera). Locating the region of interest helps in dramatically reducing both the computational expense and algorithm complexity. For example, a currently common 1024x768 resolution image contains a total of 786,432 pixels, while the region of interest may account for only 10% of the image area.

ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
pp. 108-118

Article Title: YOLO Based License Plate Detection of Violators

Also, the input to the following segmentation and recognition stages should be simplified, resulting in easier algorithm design and shorter computation times.

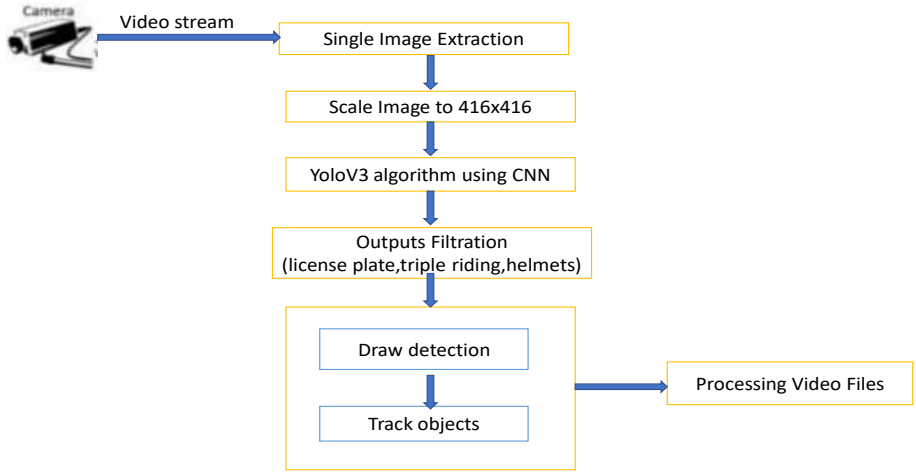
4. Proposed System

This project is on the development of new approaches for extraction of license plates. The proposed algorithm is based on video acquisition, extraction of plate region, segmentation of plate characters and recognition of characters. Extraction of plate is a difficult task. In this project, a simple license plate extraction of violators using Yolo based method is presented. The method is basically based on the Edge Detection algorithm including four major stages, which are RGB to gray-scale conversion, Gaussian Blurring, morphological operations and extracting the accurate location of the license plate. Mean squared error method is used for recognition of characters.

4.1 Proposed Methodologies

- Video acquisition
- Gaussian Blur
- RGB to gray scale conversion
- Sobel edge detection

PROPOSED SYSTEM BLOCK DIAGRAM



System Architecture

Architecture is the conceptual model that defines the structure, behaviour and views of a system. The below figure is an architectural design for the Automatic Number Plate Recognition (ANPR) system. ANPR system is a system that reads and process video that consists of vehicle number plate as input and recognizes the number plate as output automatically.

ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
pp. 108-118

Article Title: YOLO Based License Plate Detection of Violators

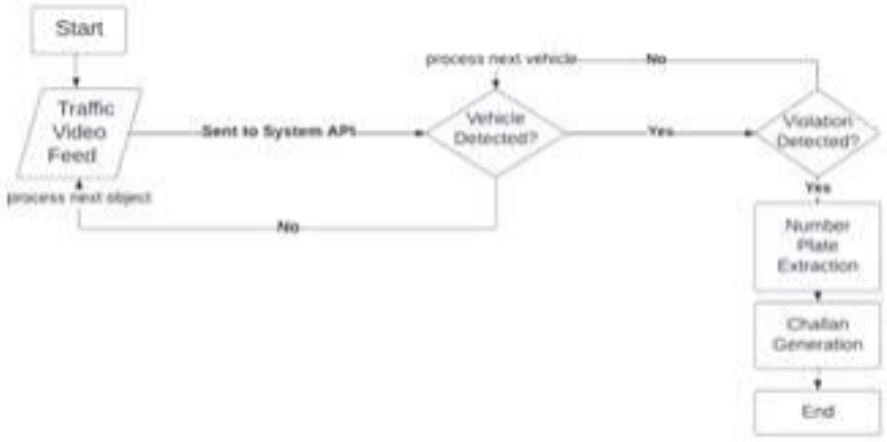


Figure 1: *System Architecture*

The proposed system operates with live video feed, recorded footage, and static images sourced from traffic cameras. When a vehicle is detected breaking traffic regulations by the model, a bounding box is drawn around the vehicle within the monitoring center. Subsequently, the captured image undergoes a series of processes through our API, encompassing object detection, license plate identification, character segmentation, and recognition. The extracted license plate number is then displayed within the Graphical User Interface (GUI), accompanied by an enlarged image of the license plate for inspection. In instances where the system encounters errors in character recognition, monitoring officers possess the capability to rectify such discrepancies using the magnified image as reference. Upon acquiring the accurate license plate number, the system initiates a query within the local RTO Database, facilitating the retrieval of pertinent vehicle information. Leveraging this data, an electronic challan is promptly generated and dispatched via email to the offending party on the same day. This integrated approach eliminates manual labor done by traffic police, showcasing the efficiency gains achieved by utilizing machine learning-based methodologies. Through this streamlined process, the system significantly accelerates the issuance of penalties for traffic violations, addressing the existing challenges associated with manual enforcement procedures.

Individual Modules

Vehicle Detection: The model leverages pretrained YOLOv8 models, which are renowned for their real-time object detection capabilities. [3] These models are applied to traffic camera footage to detect vehicles. Once a vehicle is detected, the model crops the vehicle image and sends The API then processes the image further to detect possible traffic violations. This initial step forms the foundation for subsequent analyses and actions related to traffic violations.

ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
pp. 108-118

Article Title: YOLO Based License Plate Detection of Violators

Traffic Violation Detection: This module involves the application of a YOLOv8 model specifically fine-tuned on a dataset enriched with images depicting various traffic violations. This model discerns violations such as helmetless riding, triple riding, and signal jumping. Leveraging transfer learning on a comprehensive dataset enhances the model's ability to accurately identify these infractions in real-time traffic scenarios.

License Plate Recognition using Ensemble Model: Once vehicles are detected, the images are further processed through efficient license plate identification models using Automatic Number Place Recognition (ANPR) the recognized characters are returned as a JSON object which are then displayed in the GUI of our system along with other details. We have here used an Ensemble model that combines three individual models to improve the overall accuracy and performance of the system.

API for Video Feed and GUI for Displaying Information: The system's API adeptly manages incoming video feeds from traffic cameras, while the GUI effectively presents extracted license plate numbers and violation details for further action.

Platform Selection Idle

(Short for integrated development environment or integrated development and learning environment) is an integrated development environment for Python, which has been bundled with the default implementation of the language since 1.5.2b1. It is packaged as an optional part of the Python packaging with many Linux distributions. It is completely written in Python and the Tkinter GUI toolkit (wrapper functions for Tcl/Tk). IDLE is intended to be a simple IDE and suitable for beginners, especially in an educational environment. To that end, it is cross-platform, and avoids feature clutter.

According to the included README, its main features are:

- Multi-window text editor with syntax highlighting, auto completion, smart indent and other.
- Python shell with syntax highlighting.
- Integrated debugger with stepping, persistent breakpoints, and call stack visibility.

IDLE has been criticized for various usability issues, including losing focus, lack of copying to clipboard feature, lack of line numbering options, and general user interface design; it has been called a "disposable" IDE, because users frequently move on to a more advanced IDE as they gain experience.

ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
pp. 108-118

Article Title: YOLO Based License Plate Detection of Violators

Software Testing

Unit Testing

Unit testing is a software testing method by which individual units of source code, sets one or more computer program modules together with associated control data, usage procedures and operating procedures are tested to determine if they are fit for use. Intuitively, one can view a unit as the smallest testable part of an application. In procedural programming, a unit could be an entire module, but it is more commonly an individual function or procedure. In object-oriented programming, a unit is often an entire interface, such as a class, but could also be an individual method.

System Testing

System Testing (ST) is a black box testing technique performed to evaluate the complete system the system's compliance against specified requirements. In System testing, the functionalities of the system are tested from an end-to-end perspective. System Testing is usually carried out by a team that is independent of the development team in order to measure the quality of the system unbiased. It includes both functional and Non-Functional testing.

5. Simulation Results

ISSN (Online): 2583-7052

International Journal of Advanced Trends in Engineering and Management (IJATEM)
pp. 108-118

Article Title: YOLO Based License Plate Detection of Violators

6. Conclusion

The implementation of significant leap forward in traffic enforcement technology. By harnessing the power of deep learning and computer vision, this system offers unprecedented speed, accuracy, and adaptability in identifying and documenting vehicles violating traffic regulations. Through empirical analysis and real-world applications, we have demonstrated the efficacy of the YOLO algorithm in swiftly detecting license plates with commendable precision, even in challenging environmental conditions. The integration of auxiliary technologies such as OCR further enhances the system's capabilities, enabling seamless extraction of vehicle registration information for enforcement purposes. Moreover, the deployment of such a system promises tangible benefits for law enforcement agencies, including improved efficiency, reduced manual intervention, and enhanced public safety. By automating the process of license plate detection, the system enables authorities to respond promptly to traffic violations, deter reckless driving behavior, and maintain order on the roads. However, while the current implementation represents a significant advancement, there remains ample scope for future enhancements and refinements

References

1. Paridhi Swaroop, Neelam Sharma, “An Overview of Various Template Matching Methodologies in Image Processing”, International Journal of Computer Applications (0975 – 8887) Volume 153 – No 10, November 2016.

2. Lucky Kodwani & Sukadev Meher “Automatic License Plate Recognition in Real Time Videos using Visual Surveillance Techniques”, ISSN (PRINT): 2320 – 8945, Volume -1, Issue -6, 2013.

3. Riazul Islam, Kazi Fatima Sharif and Satyen Biswas, “Automatic Vehicle Number Plate Recognition Using Structured Elements”, IEEE Conference on Systems, Process and Control December 2015, pp 44-48.

4. Muhammad Tahir Qadri, Muhammad Asif “Automatic Number Plate Recognition System for Vehicle Identification using Optical Character Recognition” IEEE 2009.

International Journal of Advanced Trends in Engineering and Management (IJATEM)
pp. 108-118

Article Title: **YOLO Based License Plate Detection of Violators**

5. Aniruddh Puranic, Deepak K. T, Umadevi V "Vehicle Number Plate Recognition System: A Literature Review and Implementation using Template Matching" International Journal of Computer Applications (0975 – 8887) Volume 134 – No.1, January 2016.

6. Byung-Gil Han, Jong Taek Lee, Kil-Taek Lim, and Yunsu Chung "Real-Time License Plate Detection in High Resolution Videos Using Fastest Available Cascade Classifier and Core Patterns" ETRI Journal, Volume 37, Number 2, April 2015.