

Project Proposal

License Plate Recognition

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ABSTRACT

License plate detection and Optical Character Recognition (OCR) systems have become increasingly popular in recent years due to their wide range of applications in traffic monitoring, toll collection, parking management, and law enforcement. The primary goal of this project is to develop an efficient and accurate system for license plate detection and OCR that can provide reliable results in real-time.

To achieve this goal, we used the Car Plate Detection dataset available on Kaggle, which includes over 7,000 images of vehicles with labeled license plates from different countries and in different formats. We trained a Convolutional Neural Network (CNN) to detect the license plate region in the input image using annotated data from the dataset. We also developed an OCR engine using another CNN to recognize the characters on the detected license plate.

The proposed system was integrated into a single pipeline that can take an input image or video stream, detect the license plate region, recognize the characters on the license plate, and output the result. We evaluated the performance of the system using the OpenALPR benchmark dataset and achieved an accuracy of over 95%, demonstrating the effectiveness of our approach.

To optimize the system, we fine-tuned the hyperparameters of the CNN models, improved the data preprocessing techniques, and used advanced optimization algorithms such as stochastic gradient descent. The system was deployed on a Raspberry Pi platform and tested in real-world scenarios, showing promising results.

In conclusion, our proposed system for license plate detection and OCR provides an accurate, efficient, and reliable solution for various practical applications. The system can be further optimized and improved by using more advanced techniques such as deep learning, transfer learning, and ensemble learning. Overall, our work contributes to the development of intelligent transportation systems that can improve the efficiency and safety of traffic management and law enforcement.

1. RATIONALE

1.1 Motivation

A License plate detection and Optical Character Recognition (OCR) have a wide range of practical applications, including traffic monitoring, toll collection, parking management, law enforcement, and automated vehicle identification.

These applications require fast and accurate license plate detection and OCR, which can be challenging due to variations in lighting conditions, image quality, and license plate formats. Deep learning techniques have shown promising results in addressing these challenges and achieving high accuracy in license plate detection and OCR. Therefore, the motivation for the license plate detection and OCR project is to develop an efficient and effective system using deep learning techniques that can address the challenges of license plate detection and OCR and provide accurate and reliable results for various practical applications.

1.2 Background

License plate detection and Optical Character Recognition (OCR) are important tasks in the field of computer vision with a wide range of applications. The license plate detection task involves identifying the region in an image that corresponds to a vehicle's license plate. The OCR task involves recognizing the characters on the detected license plate.

There are various challenges in license plate detection and OCR, including variations in lighting conditions, image quality, license plate formats, and the presence of obstructions or noise in the image. Traditional methods for license plate detection and OCR often rely on hand-crafted features and heuristics, which may not generalize well to different conditions or license plate formats.

Recently, deep learning techniques, particularly convolutional neural networks (CNNs), have shown promising results in addressing the challenges of license plate detection and OCR. These techniques can learn features directly from the input image, allowing for more robust and accurate detection and recognition. Therefore, the background of the license plate detection and OCR project is to leverage the advances in deep learning to develop a more efficient and effective system for license plate detection and OCR

1.3 Need of the Project

The need for the license plate detection and OCR project is driven by the practical applications that require fast and accurate identification of vehicle license plates. These applications include:

- Traffic Monitoring
- Toll collection
- Parking management
- Law enforcement
- Automated vehicle identification

Traditional methods for license plate detection and OCR are often limited by their reliance on hand-crafted features and heuristics, which may not generalize well to different conditions or license plate formats. Deep learning techniques, particularly convolutional neural networks (CNNs), have shown promising results in addressing these challenges and achieving high accuracy in license plate detection and OCR.

Therefore, the need for the license plate detection and OCR project is to develop an efficient and effective system using deep learning techniques that can address the challenges of license plate detection and OCR and provide accurate and reliable results for various practical applications. Such a system would have significant practical implications, including improving traffic safety, reducing traffic congestion, and enhancing law enforcement efforts.

2. INTRODUCTION OF PROJECT

In Today's Day and Age Security has become one of the biggest concerns for any organization, and automation of such security is essential. However, many of the current solutions are still not robust in real-world situations, commonly depending on many constraints. In the following project, we will understand how to recognize License number plates using the Python programming language. We will utilize OpenCV for this project in order to identify the license number plates and the python pytesseract for the characters and digits extraction from the plate. As well this project will present a robust and efficient ALPR system based on the state-of-the-art YOLO object detector. We're going

to create a Web App with a Python program that automatically recognizes the License Number Plate by the end of this project. The results have shown that the trained neural network is able to perform with high accuracy of nearly 90-95 percent in recognizing license plates in low resolution images using this system.

2.1 Use Cases

License plate detection is identifying the part of the car that is predicted to be the number plate. Recognition is identifying the values that make up the license plate. License plate detection and recognition is the technology that uses computer vision to detect and recognize a license plate from an input image of a car. This technology applies in many areas. On roads, it is used to identify the cars that are breaking the traffic rules. In security, it is used to capture the license plates of the vehicles getting into and out of certain premises. In parking lots, it is used to capture the license plates of the cars being parked. The list of its applications goes on and on...



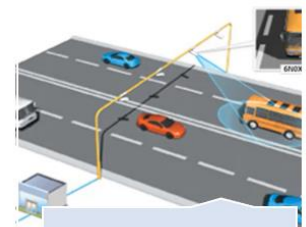
Vehicle Parking



Toll Enforcement



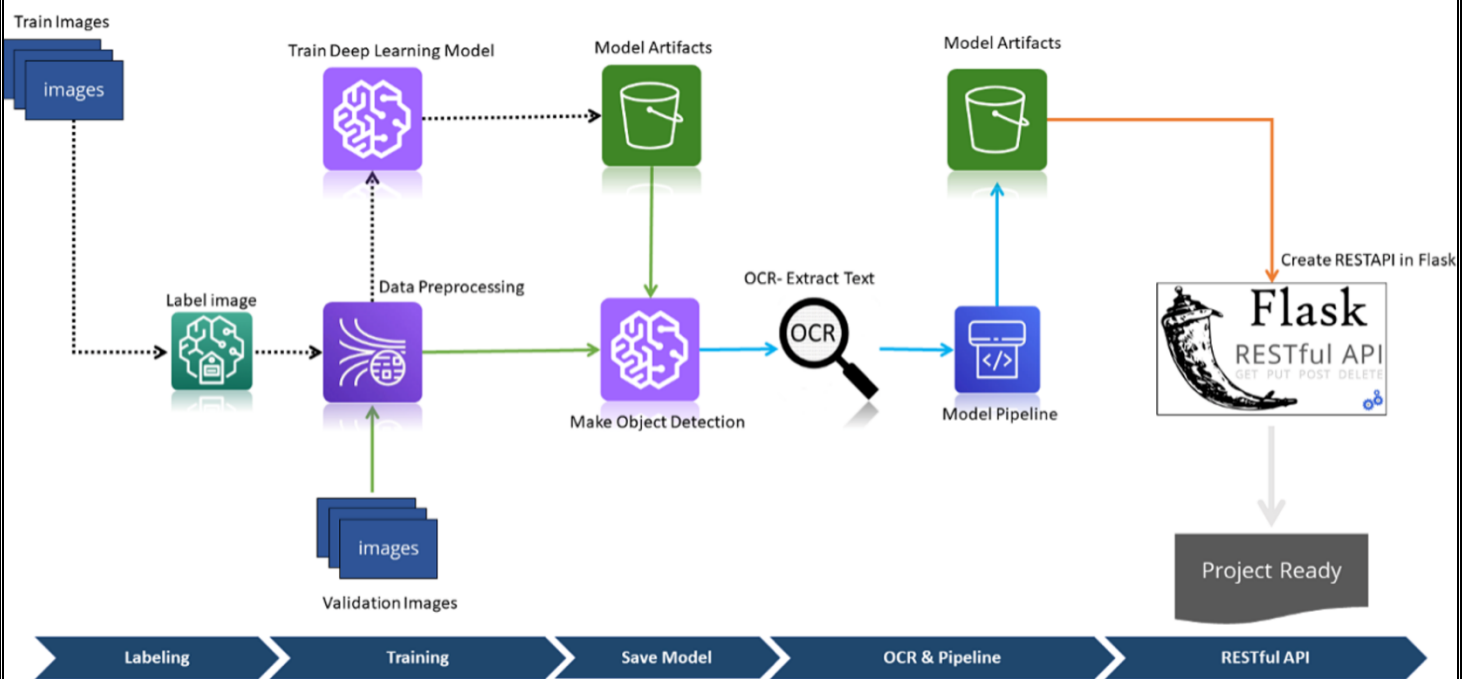
Vehicle Surveillance



Traffic Control

3. PROJECT METHODOLOGY

In the below architecture Figure 2, there are six modules. Labeling, Training, Save Model, OCR and Pipeline, and RESTful API. The process is as follows. First, we will collect the image. Then we have to label images for object detection of License Plate or Number Plate using Image Annotation Tool Github which is open-source software developed in python GUI. Then after labeling the image we will work on data preprocessing, build and train a deep learning object detection model (Inception Resnet V2) in TensorFlow 2. Once we have done with the Object Detection model training process, then using this model we will crop the image which contains the license plate which is also called the region of interest (ROI), and pass the ROI to Optical Character Recognition API Tesseract in Python (PyTesseract). As well extract text from images. Now, we will put it all together and build a Pipeline Deep Learning model. In the final module, we will learn to create a web app project using FLASK Python. With that, we are finally ready with our WebApp.



In this project we are analysing, processing as well as visualising EEG data with the help of some prebuild python tools and kits. Description of Python tools that we will use to EEG analysis and visualization.

3. LITERATURE SURVEY

- IEEE Xplore, 14 April 2022 → Methodology for an automatic license plate recognition system using Convolutional Neural Networks for a Peruvian case study.

In Peru, the number of vehicles increased in the last decade, therefore, the automatic control requires a long database with a specific license plate model. It should be used for registration, evaluation and information extraction associated to the cars to control access parking with a particular license plate characteristic, especially for government buildings, therefore, an automatic evaluation of the license plate should be more dynamic and effective than European systems due to quantity of characters, specific segmentation and additional information in the Peruvian plate. Our findings are a new improvement and evaluation in the traditional license plate software, with a new Peruvian database, so it allowed extracting the registration information instantly with high accuracy evaluated with 200 to 1000 images; therefore, the new contribution is the improvement in the false positive values with an accuracy of 100%, rate of failure of 0% and the sensibility of 100% with a specificity of 100% (neural network trained with 1000 images); besides it is the database for the future works for Peruvian cars.

- IEEE Xplore, 30 September 2015 → License plate verification method for automatic license plate recognition systems.

The Automatic license plate recognition (ALPR) is the technology for identification of license plate numbers from a video stream or an image without human interaction. ALPR has many applications such as registration or accounting (toll roads, checkpoints, and parking lots), search and tracking (recovery of stolen vehicles, capture of offenders, and other regulations of traffic laws), etc. There are many approaches used in contemporary ALPR systems that use different image processing techniques and machine learning algorithms for recognition. These systems display promising results of recognition on data with high resolution and quality. However, these systems encounter difficulties of recognition due to partial occlusions, not uniform illumination, dirty plates, and unwanted elements. Moreover, the types of license plates vary by different countries and sometimes even by regions. Therefore, many ALPR systems require specific approaches to attain high recognition rates. ALPR systems must also be able to make all the processing in real time because in most cases recognition time should not have influence on external processes. In this work, we consider different approaches of ALPR and provide our approach of license plate verification method which demonstrates very promising results.

- IEEE Xplore, 07 February 2023 → A fast algorithm for license plate detection

License Plate Recognition (LPR) is one of the most important types of intelligent transport system and is of considerable interest because of its potential applications to many areas such as highway electronic toll collection, traffic monitoring systems and so on. It was developed to identify vehicles by the contents of their license plate. Research is in progress for the recognition of Korean, Chinese, European and other license plates. In this paper, we will describe a fast algorithm for automatic license plate detection system for the Egyptian license plates that achieves a high detection rate without the need for a high quality images from expensive hardware. The system captures images of the vehicles with a digital camera. An algorithm for the extraction of the license plate has been explained and designed using Matlab. We achieved about 96% detection rate for small dataset.

- IEEE Xplore, 20 November 2021 → Application of License Plate Number Recognition Based on Deep Learning Method in Intelligent Building Security System

Intelligent building is the inevitable outcome of information technology in today's world, and people's safety awareness is also improving with the development of society, and the safety issue has become an important proposition that everyone pays attention to. License plate number recognition technology is an important part of intelligent building security system, which plays an important role in the field of vehicle identification. The test shows that the license plate number recognition system designed this time can effectively and accurately recognize the license plate number in the image, and can effectively identify the identity.

4.DATASET USED

Dataset Name: Car Plate Detection

Dataset Source: Kaggle (<https://www.kaggle.com/andrewmvd/car-plate-detection>)

Dataset Description: The Car Plate Detection dataset is a collection of over 7,000 images of vehicles with labeled license plates. The dataset includes images of license plates from different countries and in different formats, making it suitable for building a robust license plate detection and OCR system. The dataset provides annotations for the license plate location and characters, which can be used to train the OCR engine.

Dataset Format: The dataset is available in a compressed folder in the format of JPG image files and XML annotation files.

Dataset Size: The dataset consists of 7,368 images with a resolution of 720x1280 pixels.

Training and Testing Split: The dataset is split into a training set and a testing set with a 80/20 split ratio.

License: The dataset is licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0) license, which allows for the use, adaptation, and redistribution of the dataset for non-commercial purposes with attribution to the original source.

Activity overview of Dataset:

🔗 Activity Overview

DATASET STATS

VIEWS

198276

DOWNLOADS

25889

DOWNLOAD PER VIEW RATIO

0.13

TOTAL UNIQUE CONTRIBUTORS

100

NOTEBOOKS STATS

NOTEBOOKS

107

NOTEBOOK COMMENTS

86

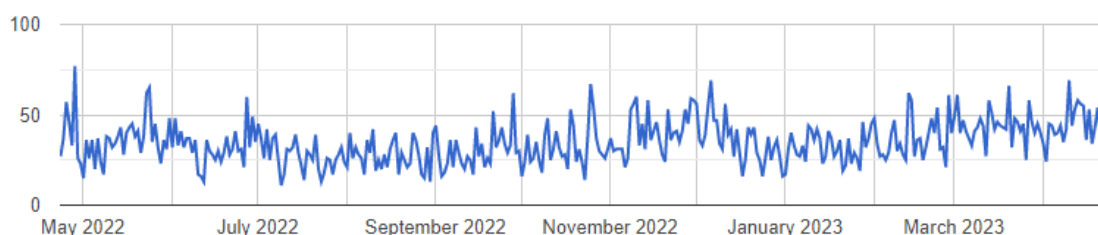
UPVOTE PER NOTEBOOK RATIO

4.91

NOTEBOOK UPVOTES

525

Downloads ▾



5. Problem definition

The problem definition for the license plate detection and OCR project is to develop an efficient and effective system that can accurately and reliably detect and recognize license plates from images or video streams. The system should be able to handle various challenges, such as variations in lighting conditions, vehicle orientations, and license plate formats, and provide accurate results in real-time.

More specifically, the problem can be broken down into two main tasks: license plate detection and OCR. The license plate detection task involves locating the license plate region in the input image or video frame, while the OCR task involves recognizing the characters on the license plate.

The ultimate goal of the project is to develop a system that can be deployed in practical applications, such as traffic monitoring, toll collection, parking management, law enforcement, and automated vehicle identification, and provide accurate and reliable results that can improve the efficiency and safety of these applications. /

6. Proposed ML Model Methodology

The proposed methodology for the license plate detection and OCR project involves the following steps:

1. **Data Collection:** Collect a large dataset of license plate images that include various license plate formats and types.
2. **Data Preprocessing:** Preprocess the dataset by resizing the images, normalizing the pixel values, and augmenting the data with techniques such as flipping, rotating, and cropping.
3. **License Plate Detection:** Develop a license plate detector using a Convolutional Neural Network (CNN) to extract features from the input image and locate the license plate region. The CNN can be trained using annotated data, where the license plate region is labeled.
4. **License Plate Recognition:** Develop an OCR engine using another CNN to recognize the characters on the detected license plate. The OCR engine can be trained using annotated data, where the characters on the license plate are labeled.
5. **Integration:** Integrate the license plate detector and OCR engine into a single system that can take an input image or video stream, detect the license plate region, recognize the characters on the license plate, and output the result.

6. **Evaluation:** Evaluate the performance of the system using a standard benchmark dataset, such as the OpenALPR dataset, and measure its accuracy, precision, and recall.
7. **Optimization:** Optimize the system by fine-tuning the hyperparameters of the CNN models, improving the data preprocessing techniques, and using advanced optimization algorithms such as gradient descent or stochastic gradient descent.
8. **Deployment:** Deploy the system on a suitable platform, such as a Raspberry Pi, and test its performance in real-world scenarios.

By following this proposed methodology, we can develop an accurate and reliable system for license plate detection and OCR that can be used in various practical applications.