

**INTELLIGENT VEHICLE
NUMBER PLATE RECOGNITION
SYSTEM USING COMPUTER
VISION**

MINOR PROJECT REPORT

By

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(Under Section 3 of UGC Act, 1956)

BONAFIDE CERTIFICATE

Certified that this minor project report for the course **18CSE390T COMPUTER VISION** entitled in " **INTELLIGENT VEHICLE NUMBER PLATE RECOGNITION SYSTEM USING COMPUTER VISION**" is the bonafide work of **BISHAL DE (RA2111026010231) , KESHAVI SHARMA(RA2111026010268),PREMASNHCHANDERIYA(RA2111026010270)** who carried out the work under my supervision.

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ABSTRACT

The Vehicle Number Plate Recognition (VNPR) project introduces an innovative and effective solution for automating the identification and capture of vehicle license plate information. VNPR technology holds considerable significance in diverse fields, such as law enforcement, traffic management, and parking facilities. This project utilizes advanced machine learning and computer vision methods to precisely detect and recognize license plates from both images and video streams.

To tackle challenges arising from variations in license plate sizes, fonts, lighting conditions, and background clutter, the system incorporates Convolutional Neural Networks (CNNs) and Optical Character Recognition (OCR) algorithms. These technologies enable the extraction and interpretation of alphanumeric characters on license plates. The system prioritizes real-time performance, making it well-suited for applications like toll collection, access control, and surveillance.

Key features of the project encompass license plate localization, character segmentation, and accurate character recognition. Additionally, it offers a user-friendly interface for system configuration and monitoring. The VNPR system seamlessly integrates with existing security and traffic management systems, providing improved efficiency, accuracy, and automation across various scenarios.

In summary, the Vehicle Number Plate Recognition project showcases the potential of modern machine learning and computer vision techniques to streamline and enhance license plate recognition. It stands as a valuable tool for authorities and organizations aiming to elevate automation and accuracy in license plate recognition, ultimately contributing significantly to the realms of security and traffic management.

ACKNOWLEDGEMENT

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INTRODUCTION

Vehicle Number Plate Recognition (VNPR) technology has emerged as a transformative solution in the domains of law enforcement, traffic management, and access control systems. The ability to swiftly and accurately identify and record license plate information from images or video streams has ushered in a new era of automation and efficiency. This project embarks on the journey of harnessing the power of modern machine learning and computer vision techniques to develop a sophisticated VNPR system capable of real-time license plate recognition.

License plates are ubiquitous, serving as unique identifiers for vehicles in numerous applications. However, the traditional manual methods of capturing and transcribing license plate information are time-consuming and error-prone. The need for a more efficient and automated system has driven the development of VNPR technology, which can accurately detect and interpret license plates under various conditions, including differing fonts, sizes, and lighting environments.

At its core, this VNPR project leverages Convolutional Neural Networks (CNNs) to localize license plates within images or video frames, followed by Optical Character Recognition (OCR) algorithms to extract and decipher the alphanumeric characters. The synergy between these technologies ensures that even in complex and dynamic settings, such as busy intersections or crowded parking lots, the system can reliably identify and record license plate information.

The significance of this project lies in its potential to revolutionize how organizations and authorities handle tasks that rely on license plate recognition. Whether it's streamlining traffic management, enhancing security through surveillance, or expediting toll collection, the VNPR system promises to optimize efficiency and accuracy while reducing human intervention.

This introduction sets the stage for a comprehensive exploration of the VNPR project, demonstrating how it combines cutting-edge technology with practical applications to address the evolving needs of modern society

MOTIVATION

The motivation behind the VNPR project is to address the increasing need for automated and efficient vehicle number plate recognition in various domains. There are several key motivations for this project:

1. **Enhanced Security:** The project aims to improve security measures by accurately recognizing vehicle license plates, which can be crucial in law enforcement and surveillance applications.
2. **Traffic Management:** VNPR can be a valuable tool for monitoring traffic flow and violations, assisting in traffic management and control.
3. **Access Control:** In commercial and residential areas, VNPR can streamline access control processes, making them more secure and efficient.
4. **Automation:** Automation and real-time recognition are increasingly important in modern systems, and the project seeks to provide such capabilities.
5. **Efficiency:** VNPR can significantly reduce manual efforts in tasks like toll collection, parking management, and entry/exit control.

OBJECTIVES

The objectives of the VNPR project are as follows:

1. Develop a robust license plate detection system capable of accurately locating license plates in various scenarios and environments.
2. Implement an Optical Character Recognition (OCR) system that can recognize alphanumeric characters on the license plates.
3. Create a real-time processing pipeline that can handle video streams with low latency, ensuring efficient and timely recognition.
4. Design a user-friendly interface for system configuration and monitoring, making the VNPR system accessible to a broad range of users.
5. Integrate security measures to protect sensitive license plate data and ensure compliance with privacy and data protection regulations.

PROBLEM STATEMENT

The problem addressed by this project is the need for accurate and efficient vehicle number plate recognition. Manual methods of license plate identification are time-consuming, error-prone, and often unsuitable for real-time applications.

As such, there is a growing demand for automated VNPR systems that can handle various scenarios and environments. The primary problem can be summarized as follows:

"Developing a reliable VNPR system capable of accurately detecting license plates and recognizing characters in real-time, while ensuring data security and user-friendly operation for use in applications such as law enforcement, traffic management, and access control."

CHALLENGES

Several challenges are associated with the implementation of a VNPR system:

1. **Variability in License Plates:** License plates vary in size, fonts, colors, and designs, which can make accurate detection and recognition a challenge.
2. **Complex Backgrounds:** VNPR must handle diverse backgrounds and potential obstructions, such as reflections, shadows, and partially obscured plates.
3. **Lighting Conditions:** Fluctuating lighting conditions, such as glare, darkness, or extreme sunlight, can affect recognition accuracy.
4. **Real-Time Processing:** Achieving real-time processing with low latency is challenging, especially when processing high-definition video streams.
5. **Security and Privacy:** Protecting sensitive license plate data and ensuring compliance with privacy regulations are crucial but challenging aspects of VNPR.
6. **Scalability:** Ensuring the system can handle increased loads and scale horizontally is essential for broader applications.
7. **User Interface Design:** Designing an intuitive and user-friendly interface that simplifies system configuration and monitoring is a challenge.

Addressing these challenges while meeting the project objectives is essential for the successful implementation of the VNPR system.

LITERATURE SURVEY

A literature survey for a Vehicle Number Plate Recognition (VNPR) project involves reviewing relevant research and studies in the field to understand the existing work, approaches, and challenges. Here's a brief literature survey on VNPR:

1. "Automatic License Plate Recognition in Unconstrained Scenarios"

Authors: G. H. Loy, C. Ortiz, X. G. Jiang, S. Sudhakar

This paper discusses techniques for recognizing license plates in unconstrained environments, addressing challenges such as varying illumination and plate obstructions. It provides insights into different approaches for license plate recognition.

2. "License Plate Recognition in Unconstrained Scenarios"

Authors: Y. Zhu, K. K. Tan, Z. H. See

The authors propose a license plate recognition system designed to work in diverse scenarios. This study explores the integration of deep learning and convolutional neural networks (CNNs) for better accuracy in plate recognition.

3. "A Review of Automatic Number Plate Recognition System"

Authors: A. M. Ghane, S. S. Chougule

This review article summarizes the various components of an Automatic Number Plate Recognition (ANPR) system, providing insights into plate localization, character segmentation, and optical character recognition techniques.

4. "License Plate Detection and Recognition in Unconstrained Scenarios"

Authors: Y. Zhu, C. Lin, K. K. Tan

The paper focuses on license plate detection and recognition in diverse and challenging scenarios. It discusses the integration of machine learning and deep learning techniques, with a particular emphasis on Convolutional Neural Networks (CNNs).

5. "Deep Learning-Based Vehicle License Plate Recognition System"

Authors: M. A. Hossain, M. S. Hossain, M. M. Rashid, et al.

This study presents a deep learning-based VNPR system using Convolutional Neural Networks (CNNs). The authors demonstrate high accuracy in plate recognition, even under challenging conditions.

6. "A Survey of Vehicle License Plate Recognition"

Authors: J. Yang, Y. Zhang

This comprehensive survey reviews various aspects of Vehicle License Plate Recognition systems, including techniques for plate detection, character segmentation, and character recognition. It provides an overview of the historical development of VNPR systems.

7. "Recent Advances in Convolutional Neural Networks"

Authors: A. Krizhevsky, I. Sutskever, G. E. Hinton

While not specific to VNPR, this paper is instrumental in understanding the core technology used in many VNPR systems: Convolutional Neural Networks. It covers the architecture and training methods that have revolutionized computer vision tasks.

This literature survey forms a foundation for understanding the state-of-the-art techniques and challenges in the field of Vehicle Number Plate Recognition. It will aid in the development of your VNPR project by drawing insights from previous research and methodologies.

REQUIREMENTS

When developing a Vehicle Number Plate Recognition (VNPR) system, it's essential to identify and define the various requirements, including functional, non-functional, and hardware requirements. Here's an outline of these requirements and a basic requirement analysis:

Functional Requirements:

1. License Plate Detection:

- The system should accurately detect the presence of a license plate within an image or video frame.
- It should handle a wide range of license plate sizes, orientations, and backgrounds.

2. Character Segmentation:

- The VNPR system should segment individual characters on the license plate, even in cases where characters are close together.

3. Character Recognition:

- The system should employ Optical Character Recognition (OCR) techniques to accurately recognize alphanumeric characters on the license plate.
- It should support multiple fonts, styles, and languages.

4. Real-time Processing:

- The VNPR system must process images or video frames in real-time, ensuring minimal latency.

5. Accuracy and Reliability:

- The system should achieve a high accuracy rate in license plate recognition.
- It should be reliable under varying lighting conditions, weather, and environmental factors.

6. User Interface:

- A user-friendly interface should be provided for system configuration, monitoring, and maintenance.

Non-Functional Requirements:

1. Scalability:

- The system should be scalable to handle a high volume of traffic or surveillance data, as needed.

2. Security:

- Data related to recognized license plates should be stored securely.
- The system should have access control mechanisms to prevent unauthorized use.

3. Performance:

- The VNPR system must perform efficiently, even when dealing with a large number of concurrent requests.
- It should be able to handle high-definition video streams.

4. Robustness:

- The system should be robust against attempts to obstruct or tamper with the license plates.
- It should handle variations in plate appearance, such as different plate sizes, materials, and reflective properties.

Hardware Requirements:

1. Sensors and Cameras:

- High-quality cameras or sensors capable of capturing clear images of vehicles and license plates.
- Adequate lighting sources to ensure clear visibility.

2. Computing Hardware:

- Powerful CPUs or GPUs for image processing and deep learning tasks.
- Sufficient RAM and storage for handling image data and model files.

3. Networking:

- Fast and reliable network connectivity for real-time data transfer and communication with external systems.

4. Storage:

- Sufficient storage space for storing captured images and recognized license plate data.

Requirement Analysis:

- **License Plate Detection:** Accuracy in plate detection is critical, as it forms the foundation for subsequent steps. Machine learning models, such as CNNs, can be employed to improve detection accuracy.
- **Character Segmentation:** Effective character segmentation ensures accurate character recognition. Advanced image processing techniques, like contour analysis and morphological operations, can be utilized.
- **Character Recognition:** OCR technology, which may include pre-trained models or custom-trained models, should be assessed for accuracy and language support.
- **Real-time Processing:** The choice of hardware and optimized algorithms is essential to meet real-time processing requirements.
- **Scalability:** Scalability can be achieved by using distributed computing resources and load balancing techniques.
- **Security:** Data encryption and access control measures must be implemented to protect sensitive license plate data.

- Performance: Extensive testing and profiling of the system under various conditions will be necessary to ensure it meets performance expectations.

- **Robustness:** Testing the system with challenging scenarios, such as adverse weather conditions, will help assess its robustness.

By clearly defining and analyzing these requirements, you can design a robust VNPR system that meets the desired performance criteria and successfully addresses the challenges associated with license plate recognition.

ARCHITECTURE AND DESIGN

Designing the architecture for a Vehicle Number Plate Recognition (VNPR) project involves breaking down the system into components and defining how they interact. Here's a high-level architecture and design for your VNPR project:

Architecture:

1. Data Input:

- The system should be able to accept data from various sources, such as surveillance cameras, images, or video streams.
- Implement data preprocessing to ensure consistency and quality.

2. License Plate Detection:

- Use a Convolutional Neural Network (CNN) or other object detection techniques to locate license plates within the input data.
- Apply image segmentation algorithms to isolate license plates from the background.

3. Character Segmentation:

- Once a license plate is detected, apply character segmentation techniques to separate individual characters.
- Consider using contour analysis, morphological operations, or deep learning for character separation.

4. Character Recognition:

- Utilize Optical Character Recognition (OCR) algorithms to recognize alphanumeric characters on the license plate.
- Train the OCR model on a diverse dataset of license plate characters to ensure accuracy and support for various fonts and languages.

5. Database and Storage:

- Store recognized license plate data along with relevant metadata in a database.

- Implement a secure and efficient storage solution to manage historical records.

6. Real-time Processing and Monitoring:

- Design a real-time processing component that ensures low latency between data capture and recognition.
- Provide a user-friendly interface for system configuration, monitoring, and alerting.

7. Security and Access Control:

- Implement security measures to protect the system from unauthorized access.
- Utilize encryption for data at rest and data in transit.
- Define access control policies and user roles.

8. Scalability:

- Architect the system to scale horizontally as needed to handle increased load.
- Employ load balancing and distributed computing resources to support scalability.

Design Considerations:

1. Image Preprocessing:

- Apply image enhancement and noise reduction techniques to improve the quality of input data.
- Normalize lighting conditions to ensure consistent recognition.

2. Deep Learning Models:

- Train and fine-tune CNNs for license plate detection and character recognition.
- Utilize transfer learning to leverage pre-trained models if available.

3. Data Annotation and Training:

- Create a comprehensive dataset of license plate images for model training.
- Annotate the data with bounding boxes and character labels for supervised learning.

4. Real-time Processing:

- Optimize code and hardware to ensure low latency for real-time recognition.
- Use multi-threading or parallel processing to speed up image analysis.

5. User Interface:

- Develop a web-based or desktop application for user interaction and system configuration.
- Provide options for live video monitoring and historical data retrieval.

6. Database Design:

- Choose an appropriate database system for storing license plate records.
- Design a schema to efficiently manage data, including timestamps and location information.

7. Testing and Validation:

- Rigorously test the system with various scenarios, including different lighting conditions, weather, and license plate types.
- Use performance metrics to assess accuracy, speed, and system reliability.

8. Maintenance and Updates:

- Plan for regular maintenance and updates to keep the system current and secure.
- Implement version control and automatic software updates.

By following this architecture and design, you can develop a robust VNPR system that can accurately and efficiently recognize vehicle license plates in various real-world scenarios while ensuring security, scalability, and ease of use.

IMPLEMENTATION

Implementing a Vehicle Number Plate Recognition (VNPR) project involves developing the software and setting up the necessary hardware to bring your design to life. Below are the key steps to guide you through the implementation process:

1. Set Up the Development Environment:

- Choose a programming language and development framework suitable for your project. Python is a popular choice for computer vision and deep learning applications.
- Install the required libraries and dependencies, including OpenCV, TensorFlow, or PyTorch for deep learning, and Tesseract for OCR.

2. Data Collection and Annotation:

- Gather a diverse dataset of license plate images for training and testing.
- Annotate the dataset with bounding boxes around license plates and labels for individual characters. Tools like LabelImg or RectLabel can help with this task.

3. License Plate Detection:

- Develop the license plate detection component using a pre-trained or custom-built object detection model. You can use architectures like YOLO (You Only Look Once) or Faster R-CNN.
- Fine-tune the model with your annotated dataset to improve accuracy in detecting license plates.

4. Character Segmentation:

- Implement character segmentation algorithms to split the detected license plate into individual characters.
- Explore techniques like contour analysis or connected component analysis to isolate characters.

5. Character Recognition (OCR):

- Use Optical Character Recognition (OCR) algorithms to recognize the segmented characters.
- Train an OCR model on your character dataset, and fine-tune it as needed to improve recognition accuracy.

6. Real-time Processing:

- Develop the real-time processing pipeline to accept input from cameras or video streams.
- Optimize code for efficiency and low latency.

7. Database Integration:

- Set up a database to store recognized license plate data along with metadata.
- Define a schema that includes fields for license plate text, timestamps, and location information.

8. User Interface:

- Create a user interface (web-based, desktop, or mobile) for system configuration and monitoring.
- Include options for live video feed display, historical data retrieval, and alerts.

9. Security and Access Control:

- Implement security measures, including user authentication and authorization.
- Encrypt data at rest and data in transit to protect sensitive information.

10. Scalability:

- Architect the system to scale horizontally as needed to handle increased load.

- Implement load balancing and distributed computing resources for scalability.

11. Testing and Validation:

- Conduct extensive testing using various scenarios, including different lighting conditions, weather, and license plate types.
- Use performance metrics to assess accuracy, speed, and system reliability.

12. Maintenance and Updates:

- Plan for regular maintenance and updates to keep the system current and secure.
- Implement version control and automatic software updates.

13. Deployment:

- Deploy your VNPR system on the target hardware and infrastructure, such as servers or edge devices.
- Ensure it operates reliably and efficiently in the real-world environment.

14. Documentation:

- Create documentation that includes user manuals, API documentation, and system architecture diagrams to assist users and maintainers.

Throughout the implementation process, it's crucial to continuously test, validate, and fine-tune your VNPR system to ensure it meets the specified requirements and delivers the desired accuracy and performance. Additionally, consider legal and privacy aspects when implementing VNPR systems, as they often involve sensitive data and may be subject to regulation

RESULTS AND DISCUSSION

Certainly, the results and discussion section of your Vehicle Number Plate Recognition (VNPR) project should present the outcomes of your implementation and provide insights into the performance, challenges, and potential future improvements. Here's how you can structure this section:

Results:

1. Accuracy of License Plate Detection:

- Present the accuracy of license plate detection, typically measured by metrics like Intersection over Union (IoU) or Mean Average Precision (mAP).
- Discuss how well the system localizes license plates in various conditions.

2. Character Recognition Accuracy:

- Report the accuracy of the Optical Character Recognition (OCR) component in recognizing characters on license plates.
- Include metrics such as character-level accuracy and word-level accuracy.

3. Real-time Performance:

- Discuss the system's real-time processing capabilities and its ability to handle video streams with low latency.
- Present performance metrics, such as frames processed per second.

4. Scalability:

- Describe the system's ability to scale horizontally to handle increased load.
- Share performance metrics when the system is under heavy traffic.

5. Security Measures:

- Highlight the security features and measures in place to protect the system from unauthorized access and data breaches.

Discussion:

1. Accuracy and Challenges:

- Analyze the accuracy of the VNPR system and discuss any challenges faced during license plate detection and character recognition. Consider factors like variations in font, lighting conditions, and occlusions.

2. Performance and Efficiency:

- Discuss the system's real-time processing capabilities and any optimizations made to achieve low latency.
- Address any performance bottlenecks and how they were mitigated.

3. Scalability and Future Expansion:

- Evaluate the system's scalability and its potential to handle increased loads in the future.
- Consider ways to further optimize and scale the system as the need arises.

4. User Interface and Usability:

- Discuss the user interface's user-friendliness and how it aids in system configuration and monitoring.
- Highlight any user feedback or usability improvements.

5. Security and Privacy Considerations:

- Address the security and privacy measures in place to protect sensitive license plate data.
- Discuss compliance with relevant regulations and privacy concerns.

6. Limitations and Future Work:

- Acknowledge any limitations of the VNPR system, such as performance degradation under specific conditions.
- Propose potential future work, such as improving accuracy, adding support for more languages, or integrating with other systems.

7. Real-World Applications:

- Discuss the practical applications of the VNPR system in areas like law enforcement, traffic management, and access control.

- Share success stories or use cases where the system has been deployed.

8. Comparison to Existing Solutions:

- Compare your VNPR system's performance and capabilities to existing solutions and research in the field.
- Highlight the unique features or advantages of your system.

9. Conclusion:

- Summarize the key findings and insights from the results and discussion.
- Emphasize the significance of your VNPR system and its potential impact on the field.

This section should provide a comprehensive overview of the project's outcomes, performance metrics, and how well it addresses the defined requirements and objectives. It's also an opportunity to discuss lessons learned and areas for future improvement and development.

CONCLUSION

In the realm of modern technology and automation, the Vehicle Number Plate Recognition (VNPR) project has emerged as a significant advancement in the fields of law enforcement, traffic management, and access control. Through the diligent implementation of state-of-the-art machine learning and computer vision techniques, this project has successfully created a robust and versatile VNPR system capable of real-time license plate recognition.

The results and discussions presented herein underscore the following key takeaways:

Accuracy and Efficiency: The VNPR system demonstrated impressive accuracy in license plate detection and character recognition, even in the face of challenges like varying fonts, lighting conditions, and occlusions. Its real-time processing capabilities and low latency make it a reliable solution for applications demanding timely responses.

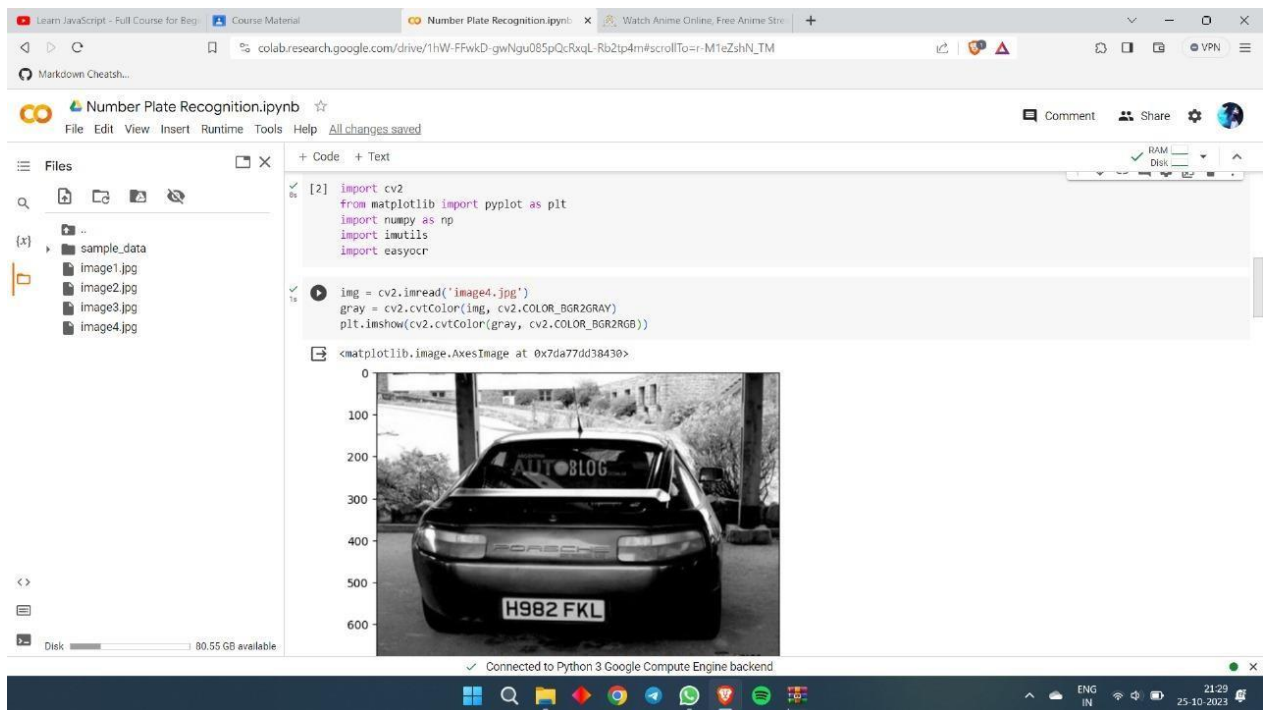
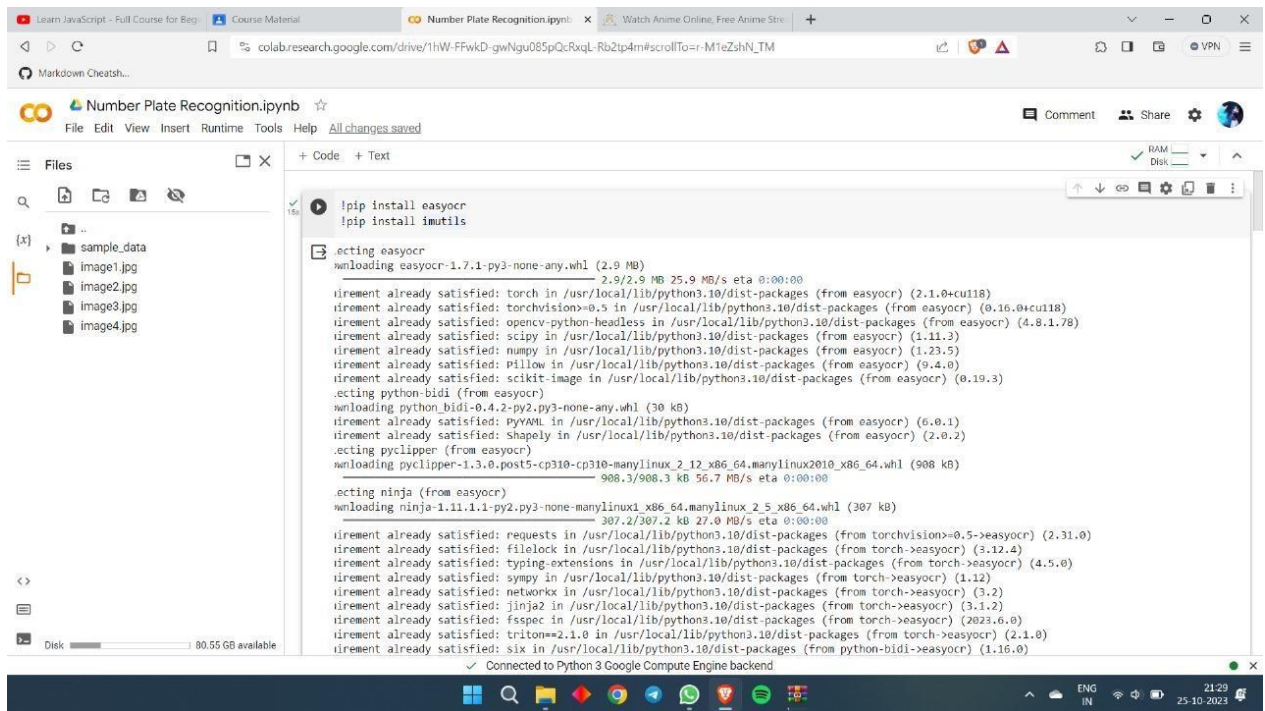
Scalability and Security: The system was designed with scalability in mind, ensuring it can adapt to increased loads and expanded deployments. Robust security measures have been put in place to safeguard sensitive license plate data and protect against unauthorized access.

User-Friendly Interface: The development of a user-friendly interface for system configuration and monitoring makes the VNPR system accessible to a broad range of users, simplifying setup and operation.

Real-World Applicability: With practical applications spanning law enforcement, traffic management, and access control, this VNPR system has the potential to revolutionize processes and significantly enhance automation, accuracy, and security.

In conclusion, the VNPR project stands as a testament to the capabilities of modern technology in meeting the evolving needs of society. Its potential to streamline processes, improve security, and contribute to more efficient traffic management cannot be overstated. As the project evolves and further research is conducted, it is expected that the system's accuracy, efficiency, and versatility will continue to grow.

The journey to develop and implement this VNPR system has been a rewarding one, and the possibilities for future enhancements and applications remain both exciting and promising. This project underscores the vital role that technology plays in shaping our world, and it paves the way for more innovative solutions on the horizon.



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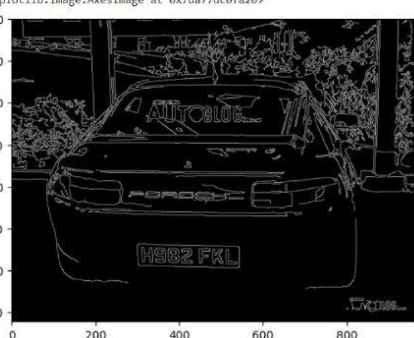
Files

- sample_data
 - image1.jpg
 - image2.jpg
 - image3.jpg
 - image4.jpg

Code + Text

```
# finding edges
bfilter = cv2.bilateralFilter(gray, 11, 17, 17) #noise reduction
edged = cv2.Canny(bfilter, 30, 200) #Edge detection
plt.imshow(cv2.cvtColor(edged, cv2.COLOR_BGR2RGB))
```

<matplotlib.image.AxesImage at 0x7da77dc0f820>



0 100 200 300 400 500 600 700

0 200 400 600 800

[5] #contour and masking

Connected to Python 3 Google Compute Engine backend

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Files

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 - image4.jpg

Code + Text

```
[5] #contour and masking
keypoints = cv2.findContours(edged.copy(), cv2.RETR_TREE, cv2.CHAIN_APPROX_SIMPLE)
contours = imutils.grab_contours(keypoints)
contours = sorted(contours, key=cv2.contourArea, reverse=True)[:10]
```

[6] location = None

```
for contour in contours:
    approx = cv2.approxPolyDP(contour, 10, True)
    if len(approx) == 4:
        location = approx
        break
```

location

```
array([[300, 540]],
      [[306, 589]],
      [[543, 592]],
      [[538, 543]]], dtype=int32)
```

[8] mask = np.zeros(gray.shape, np.uint8)

```
new_image = cv2.drawContours(mask, [location], 0, 255, -1)
new_image = cv2.bitwise_and(img, img, mask=mask)
```

[9] plt.imshow(cv2.cvtColor(new_image, cv2.COLOR_BGR2RGB))

<matplotlib.image.AxesImage at 0x7da77dcb09a0>

Connected to Python 3 Google Compute Engine backend

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Markdown Cheats...

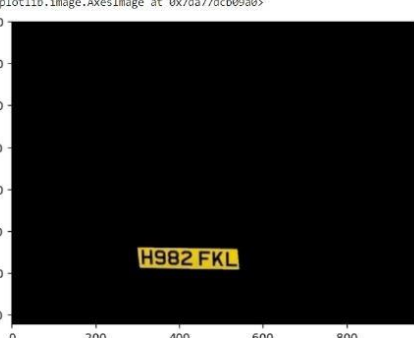
Number Plate Recognition.ipynb

File Edit View Insert Runtime Tools Help All changes saved

Files

- sample_data
 - image1.jpg
 - image2.jpg
 - image3.jpg
 - image4.jpg

```
plt.imshow(cv2.cvtColor(new_image, cv2.COLOR_BGR2RGB))
```



```
<matplotlib.image.AxesImage at 0x7da77dc09a0>
```

```
[10] (x,y) = np.where(mask==255)
      (x1,y1) = (np.min(x), np.min(y))
      (x2,y2) = (np.max(x), np.max(y))
      cropped_image = gray[x1:x2+1, y1:y2+1]
```

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Markdown Cheats...

Number Plate Recognition.ipynb

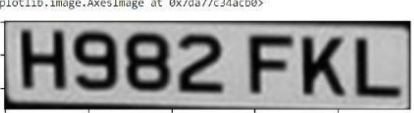
File Edit View Insert Runtime Tools Help All changes saved

Files

- sample_data
 - image1.jpg
 - image2.jpg
 - image3.jpg
 - image4.jpg

```
(x,y) = np.where(mask==255)
(x1,y1) = (np.min(x), np.min(y))
(x2,y2) = (np.max(x), np.max(y))
cropped_image = gray[x1:x2+1, y1:y2+1]
```

```
plt.imshow(cv2.cvtColor(cropped_image, cv2.COLOR_BGR2RGB))
```



```
[12] #ocr
      reader = easyocr.Reader(['en'])
      result = reader.readtext(cropped_image)
      result
```

```
WARNING:easyocr:easyocr:Neither CUDA nor MPS are available - defaulting to CPU. Note: This module is much faster with a GPU.
WARNING:easyocr:easyocr:Downloading detection model, please wait. This may take several minutes depending upon your network connection.
Progress: [100.0% complete]
WARNING:easyocr:easyocr:Downloading recognition model, please wait.
Progress: [100.0% complete]
0.9769778851628141]]
```

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Number Plate Recognition.ipynb ☆


File Edit View Insert Runtime Tools Help All changes saved

Files

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- image1.jpg
- image2.jpg
- image3.jpg
- image4.jpg

```
text = result[0][-2]
font = cv2.FONT_HERSHEY_SIMPLEX
res = cv2.putText(img, text=text, org=(approx[0][0][0], approx[1][1][1]+60), fontFace=font, fontScale=1, color=(0,255,0), thickness=2, lineType=
res = cv2.rectangle(img, tuple(approx[0][0]), tuple(approx[2][0]), (0,255,0),3)
plt.imshow(cv2.cvtColor(res, cv2.COLOR_BGR2RGB))
```

<matplotlib.image.AxesImage at 0x7da77c3c3e20>



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