AUTOMATED LICENSE PLATE RECOGNITION SYSTEM

GROUP NO. 20

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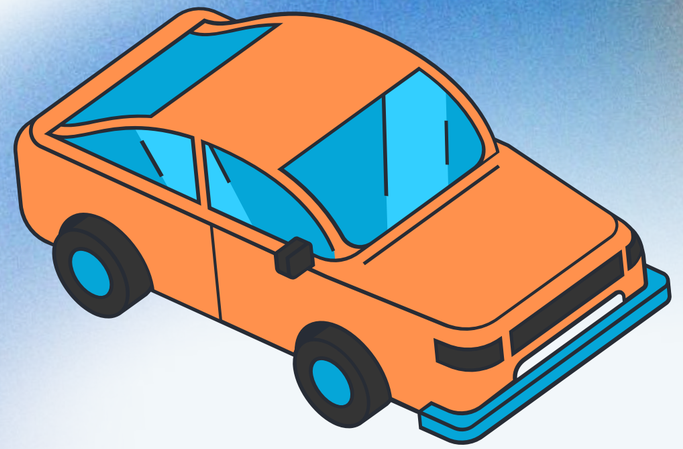

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PROJECT OVERVIEW

01 Develop an automated system capable of detecting and reading license plates from vehicle images with high accuracy.

02 Implement region-based segmentation to precisely identify and extract the license plate area from the image.

03 Enhance image quality using advanced image processing techniques for better recognition and clarity.

04 Integrate Optical Character Recognition (OCR) to accurately extract and interpret text from detected license plates.

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WHAT DO YOU MEAN BY

AUTOMATED LICENSE PLATE RECOGNITION SYSTEM

Automatic License Plate Recognition (ALPR) is an advanced form of License Plate Recognition (LPR) that uses computer vision, machine learning, and artificial intelligence to automatically detect, capture, and recognize vehicle license plate numbers from images or video streams.

→ KEY FEATURES:

- Automated Processing – No human intervention is required to detect or read license plates.
- Real-Time Recognition – Can process images and video feeds instantly.
- High Accuracy – Uses AI models to improve recognition in varied lighting, angles, and weather conditions.
- Integration with Databases – ALPR systems can match recognized plates with law enforcement, toll, or parking databases.

TECHNOLOGIES USED

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- DEEP LEARNING FOR OBJECT DETECTION

1. YOLOv5 (You Only Look Once) – Fast & accurate object detection model.
2. Pretrained models for quick adaptation.

- Optical Character Recognition (OCR)

1. Tesseract OCR / EasyOCR* – Converts license plate images into text

- Libraries & Tools

1. Python, OpenCV, PyTorch, Torchvision, Tesseract OCR, EasyOC

YOLOV5:

A POWERFUL MODEL FOR OBJECT DETECTION IN ALPR SYSTEMS

YOLOv5 follows a single-stage object detection approach, meaning it detects objects in one pass through the neural network instead of scanning the image multiple times.

HOW YOLOV5 WORKS?

- Takes an input image and resizes it.
- CNN extracts features like edges and shapes.
- Divides the image into a grid for detection.
- Predicts bounding boxes & class labels for objects.
- Filters overlapping boxes using Non-Maximum Suppression (NMS).
- Outputs license plate region for further processing (OCR).

DATA COLLECTION FOR ALPR

SOURCES OF IMAGES:

- Public Datasets: OpenALPR, AOLP, UFPR-ALPR (labeled license plates).
- Custom Datasets: Traffic/security cameras, dashcams.

CHALLENGES IN DATA COLLECTION:

- Lighting Issues: Nighttime glare, bright sunlight.
- Different Plate Formats: Vary by country.
- Motion Blur: Fast-moving vehicles affect clarity.

WHY HIGH-QUALITY DATA?

Better training data = Higher accuracy in real-world scenarios!

IMAGE PRE-PROCESSING

→ WHY PRE-PROCESS IMAGES?

Raw images have noise, lighting variations, and unnecessary details, making license plate detection difficult.

→ PREPROCESSING STEPS:

- Grayscale Conversion: Simplifies processing by removing color.
- Contrast Enhancement: Highlights characters for better recognition.
- Image Resizing: Ensures uniform input size.
- Noise Reduction: Uses filters like Gaussian Blur for clarity

→ KEY TECHNIQUES:

- Histogram Equalization: Improves contrast in low-light images.
- Gaussian Blur: Reduces noise for a smoother image.

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REGION-BASED SEGMENTATION

→ WHAT IS SEGMENTATION?

Segmentation is the process of dividing an image into meaningful parts to isolate the license plate.

→ TECHNIQUES USED:

- Edge Detection: Detects boundaries of objects in an image (Canny Edge Detection).
- Region Growing: Identifies groups of connected pixels with similar intensity values.
- Morphological Operations:

1. Dilation - Expands bright areas to strengthen character edges.
2. Erosion - Removes small noise and refines object boundaries.

→ WHY SEGMENTATION IS CRUCIAL?

If segmentation fails, the system cannot correctly detect the license plate area, affecting the accuracy of the final output.

LICENSE PLATE LOCALIZATION

→ HOW DO WE LOCATE THE PLATE?

- **Contour Detection:** Finds closed shapes (rectangles) in the image to locate the plate.
- **Bounding Box Extraction:** Draws a rectangle around the detected plate region.
- **Perspective Correction:** If the plate is tilted, it is adjusted using an Affine Transformation to make characters readable and it ensures accurate text extraction.

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CHARACTER SEGMENTATION

Once the license plate is isolated, we need to separate each letter and number individually.

→ STEPS:

- Thresholding: Converts grayscale image to black-and-white for clear distinction.
- Contour Detection: Identifies boundaries of characters.
- Bounding Box Extraction: Extracts each character separately.

→ CHALLENGES:

- Overlapping or touching characters.
- Variations in font size and style.
- Presence of unwanted symbols or dirt on plates.

OPTICAL CHARACTER RECOGNITION (OCR)

→ WHAT IS OCR?

OCR is a technology that converts images of text into machine-readable characters.

→ OCR PROCESS:

- Input: Segmented characters from the license plate.
- Feature Extraction: Identifies letter and number shapes.
- Recognition: Uses a trained model (e.g., Tesseract) to match the extracted features with stored alphabets/numbers.
- Output: Returns recognized text

LICENSE PLATE OUTPUT

The recognized license plate number is displayed on the screen or stored in a database.
This information can be used for:

- Parking logs.
- Toll collection systems.
- Traffic law enforcement.

→ NEXT STEPS AFTER RECOGNITION:

- The system can match the plate number with a database to find registered owner details.
- It can send alerts for unauthorized vehicles.

REAL-LIFE APPLICATION:

1. Automated Toll Collection: Enables automatic vehicle identification for toll payments.
2. Traffic Monitoring: Detects speed violations and tracks stolen vehicles.
3. Parking Systems: Manages parking lots by identifying incoming and outgoing cars.
4. Security & Surveillance: Tracks vehicles entering restricted areas.

CHALLENGES & SOLUTIONS:

Key Challenges:

- Poor Image Quality – Low resolution affects OCR accuracy.
- Lighting Variations – Shadows and bright reflections can obscure characters.
- Plate Design Variations – Different fonts, colors, and symbols in various countries.

Solutions:

- AI-based Image Enhancement for better clarity.
- Adaptive Thresholding to adjust brightness levels.
- Deep Learning for improved recognition accuracy.

THANK YOU