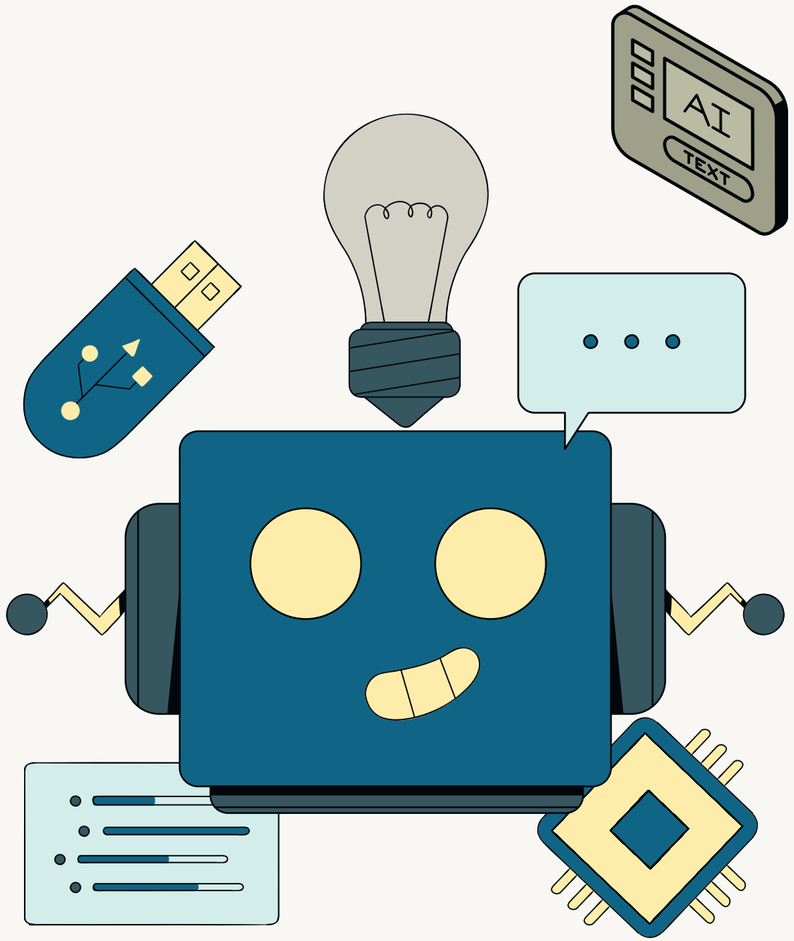
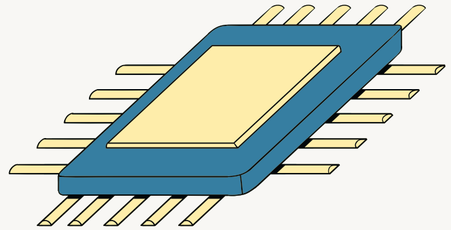
UCSI University FYP Presentation



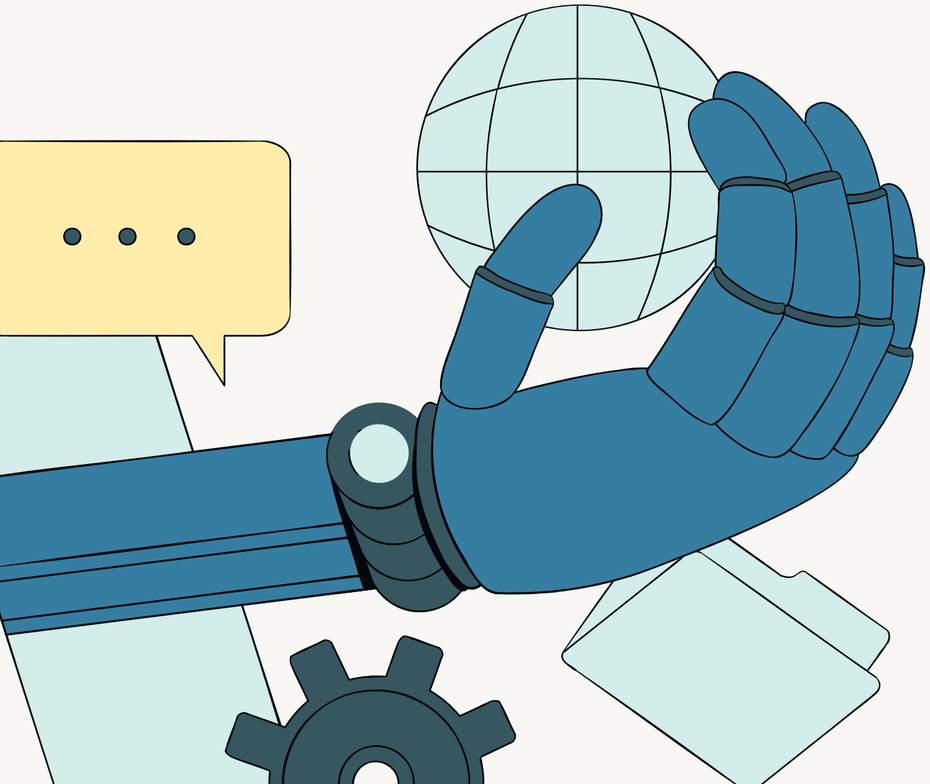
OPTIMIZING AUTOMATION LICENSE PLATE RECOGNITION(ALPR) PERFORMANCE THROUGH ADAPTIVE IMAGE PROCESSING TECHNIQUES

presented by: Yeoh Zhi Ying (1001953809)

Supervisor: Dr. Mohammad Arif Bin Ilyas

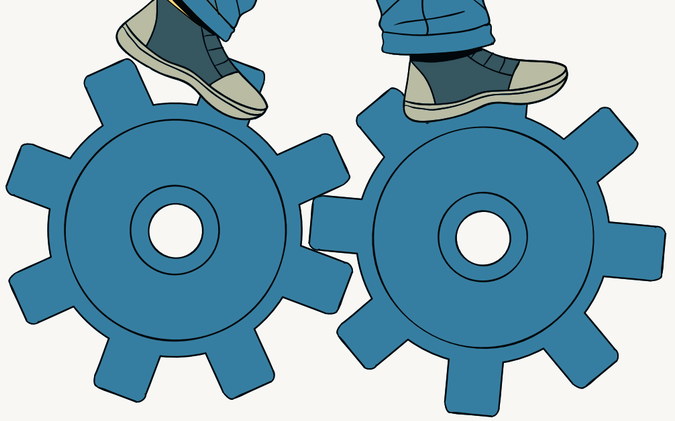


Automation License Plate Recognition (ALPR)

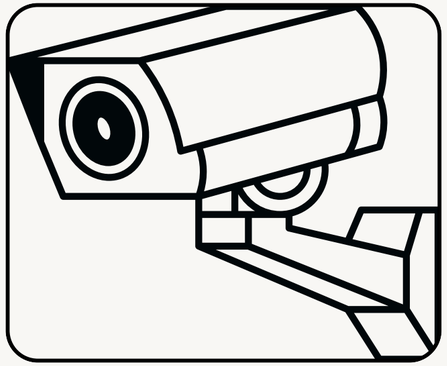


- Technology to capture and read vehicle registration plate.
- Used in law enforcement, traffic management, toll collection, parking management, and access control.
- Used for vehicles identification, security and monitoring

ALPR SYSTEM OVERVIEW

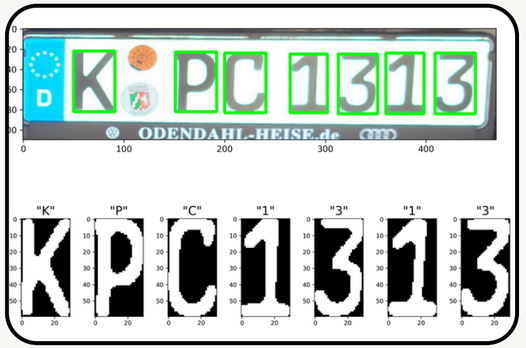


CAMERA CAPTURED VEHICLE



LICENSE PLATE DETECTION

CHARACTER RECOGNITION



LICENSE PLATE NUMBER SHOWN

KPC1313

Automation License Plate Recognition (ALPR)

Challenges:

- **Environmental conditions**
  - **day, night, sunny, rainy**
- **Unfavourable conditions**
  - **sight impedance, add complexity to recognition**
- **Poor image quality**
  - **Unclear or noisy license plate images**

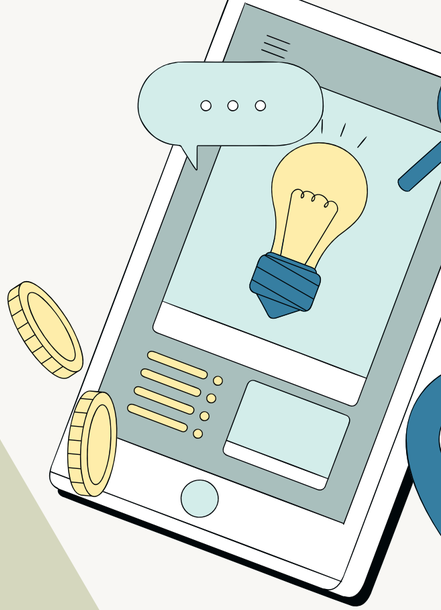
Objectives

Develop a baseline ALPR system for standard license plate detection and recognition.

Compare image processing techniques for enhanced license plate image quality, particularly in low light and adverse weather conditions.

Assess ALPR image processing techniques with real-life scenario images for better accuracy.

ALPR development process



License Plate Recognition

License Plate Detection

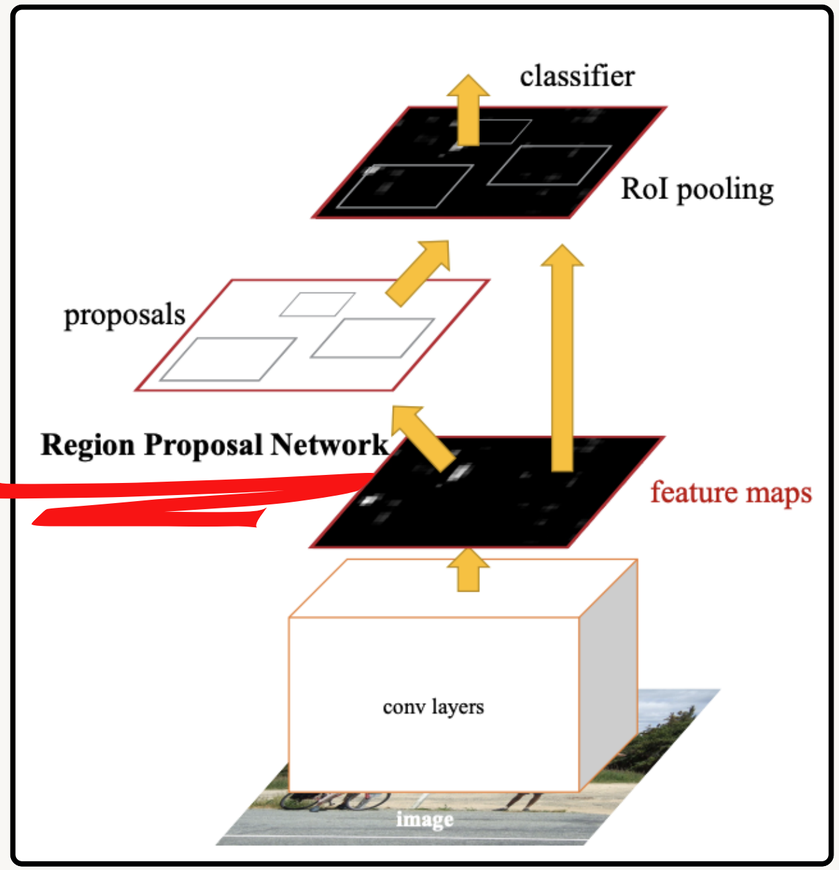
Faster R-CNN

ALPR System

Image processing techniques

Enhanced Accuracy

License Plate Detection



- Faster R-CNN model was used and implemented after compared with CNN and YOLO model.

Faster R-CNN vs CNN

- Faster R-CNN model with the RPN can achieve high precision compared with CNN model.

Faster R-CNN vs YOLO

- YOLO: fast detection speed , low precision

License Plate Recognition

Paddle OCR

An open-source deep learning OCR framework, 95% accuracy

Faster R-CNN

Faster R-CNN has CNN backbone, achieving 99.94% of accuracy.

Tesseract OCR

Achieved 81% in recognition text characters

Easy OCR

Achieved an accuracy of around 95.3%

ALPR System

License Plate Recognition

Start detection... BNE1697_PLAT_0.jpg
B_100.00_7_99.99_1_99.99_6_99.99_9_99.98_E_99.92_N_99.92_
BNE1697
Done! Took 2.54 seconds

License Plate Detection Result

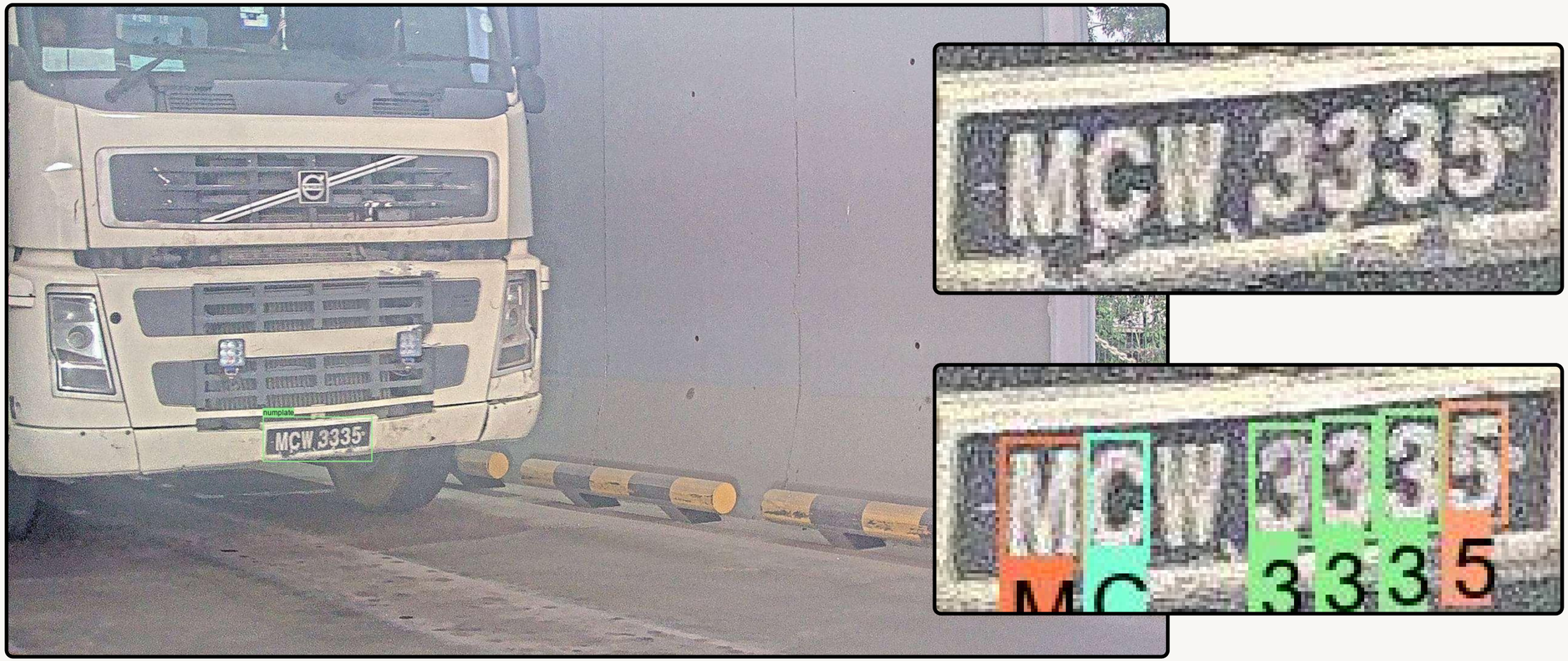


Image Processing Techniques

To stand out the characters from the background plate

Improve the LPR performance

Improves ALPR system effectiveness in diverse environmental conditions.

Without implementing image processing techniques

With implementing image processing techniques

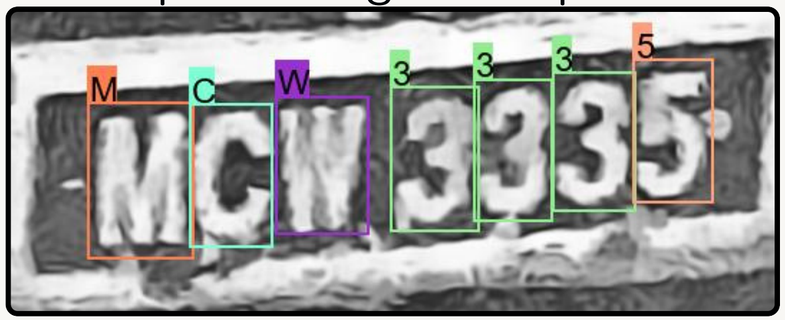


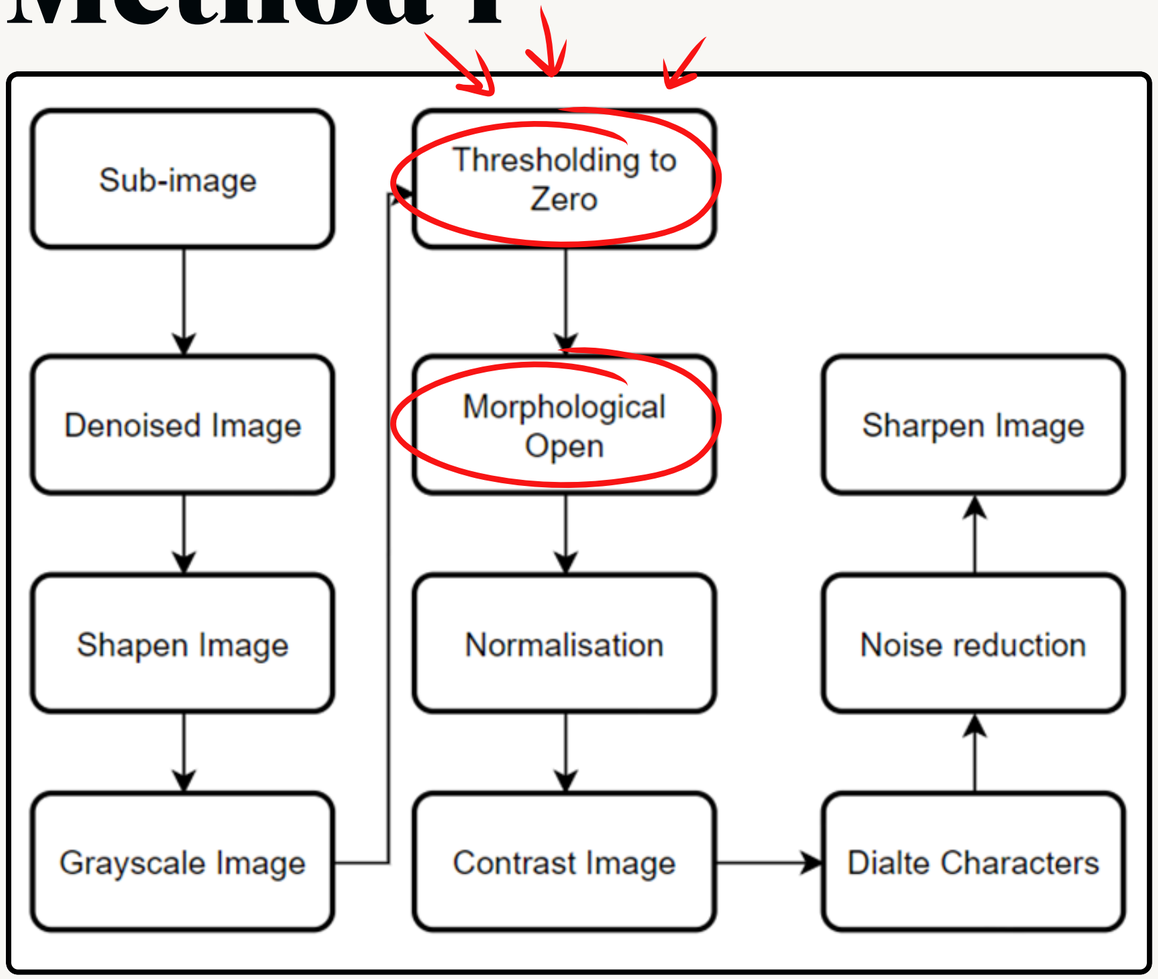
Image Processing Techniques Flow

Concept representing a systematic pipeline of image processing techniques.

This structured approach involves sequentially applying various image processing methods, including but not limited to noise reduction, edge detection, feature extraction, and image enhancement.

Improving image quality, and extracting meaningful information.

Image Processing Technique Flow: Method 1



- **Noise Removal and Character Sharpening**
- **Contrast Enhancement and Thresholding**
- **Morphological Operations**
- **Consistency through Normalization**
- **Advanced Noise Reduction Techniques**

Method 1 uses Thresholding to Zero and morphological opening to enhance ALPR accuracy, making letters stand out for improved recognition.

Original Image (INPUT)

Grayscale

Thresholding to Zero

Morphological Open

Normalisation

Contrast

Morphological Dilate

Noise Reduction

Sharpen (OUTPUT)

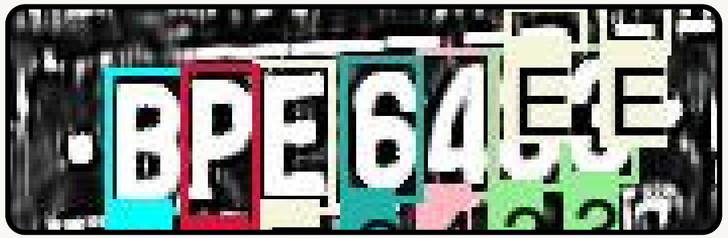
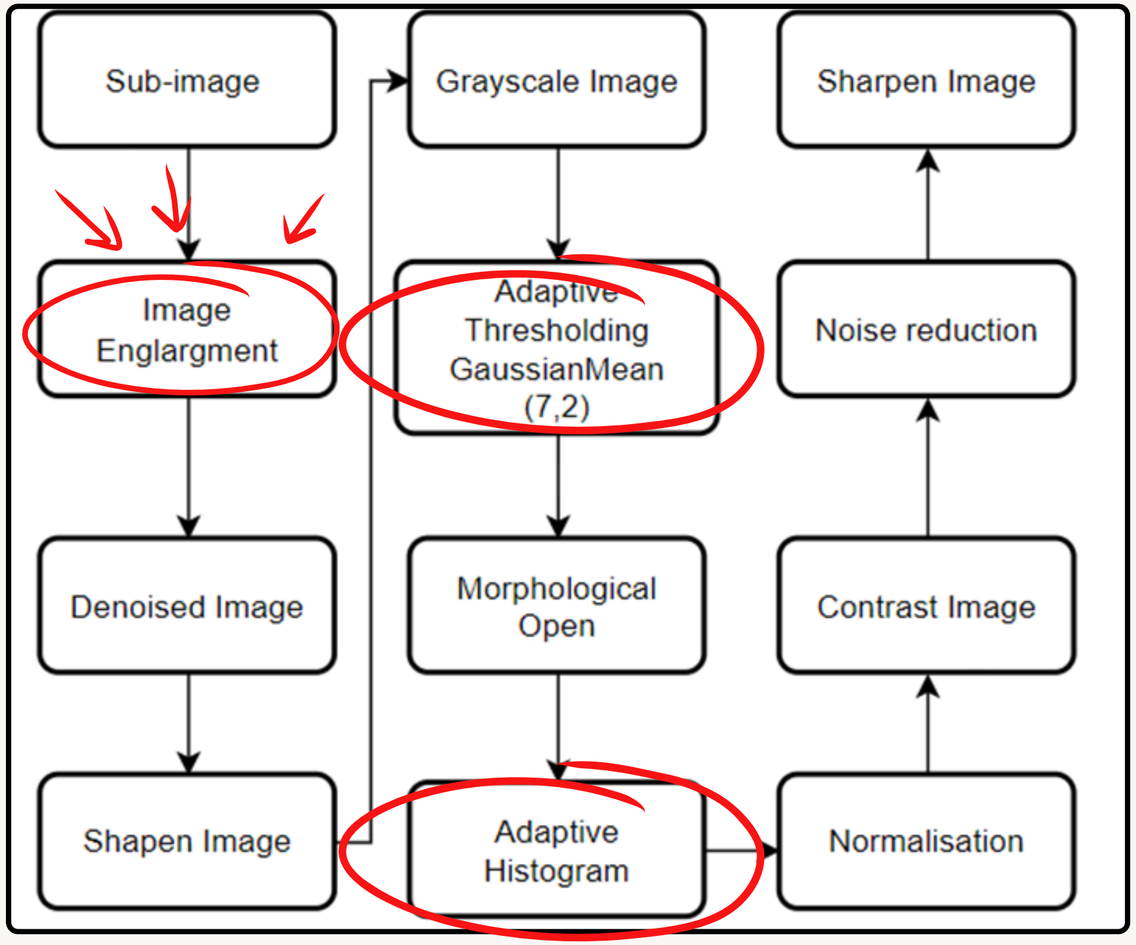


Image Processing Technique Flow: Method 2

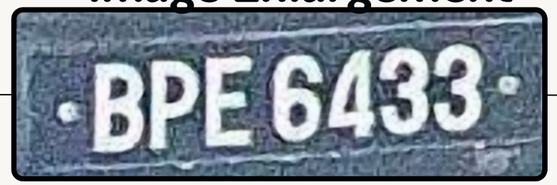


- **Image Enlargement with ESPCN Model**
- **Adaptive Thresholding Gaussian Mean (ATGM)**
- **Morphological Operations and Adaptive Histogram Equalization (AHE)**
- **Consistency through Normalization**
- **Advanced Noise Reduction Techniques**

Method 2 utilizes AI Image Enlargement and ATGM to addressing uneven lighting and low resolution.

Original Image (INPUT)

Image Enlargement



Grayscale

ATGM

Morphological Open

Adaptive Histogram

Normalisation

Contrast

Noise Reduction

Sharpen (OUTPUT)

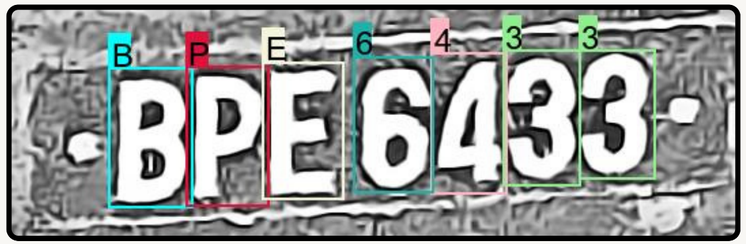
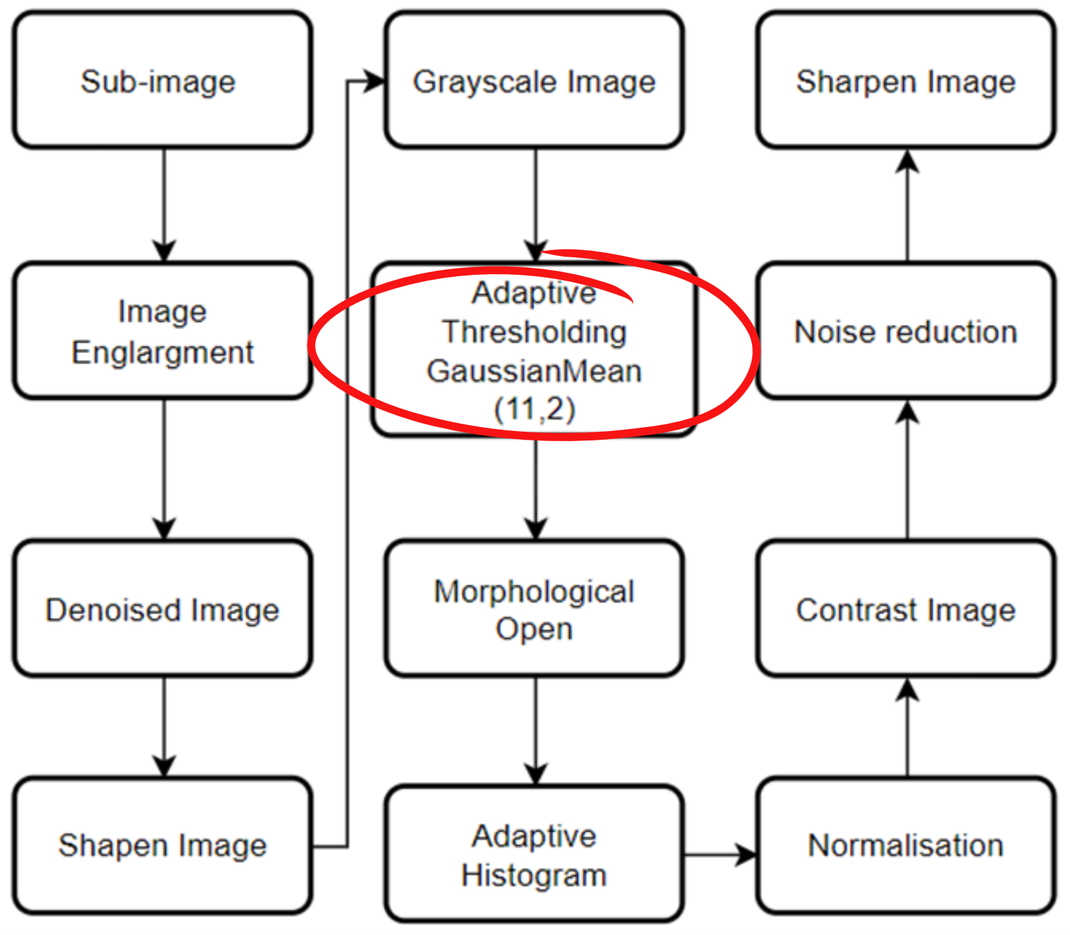


Image Processing Technique Flow: Method 3



- **Similarity to Method 2**
- **Difference in Block Size**
- **Impact on Adaptive Thresholding**
- **Enhanced Contrast and Visibility**

Method 3 using a larger block size in adaptive thresholding calculates the local mean based on an 11x11 neighborhood. This enhances contrast by covering a broader region, beneficial for images with white characters on a black background.

Original Image (INPUT)

Image Enlargement

Grayscale

ATGM

Morphological Open

Adaptive Histogram

Normalisation

Contrast

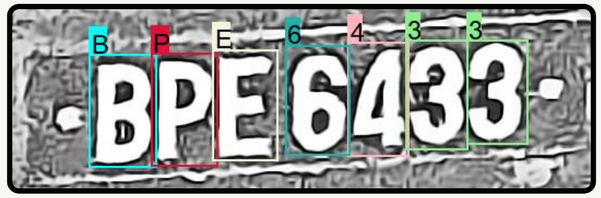
Noise Reduction

Sharpen (OUTPUT)

Method 1

B	P	E	6	4	3	3	Time Taken
B_100.00	P_99.98	E_100.00	6_99.97	4_99.98	3_99.98, E_83.37	3_99.84,E _81.11	2.26 s

Method 2



B	P	E	6	4	3	3	Time Taken
B_100.00	P_99.99	E_99.99	6_99.99	4_100.00	3_99.99	3_99.99	2.70s

Method 3

B	P	E	6	4	3	3	Time Taken
B_99.98	P_99.92	-	6_99.92	4_99.56	3_100.00	3_100.00	2.42 s

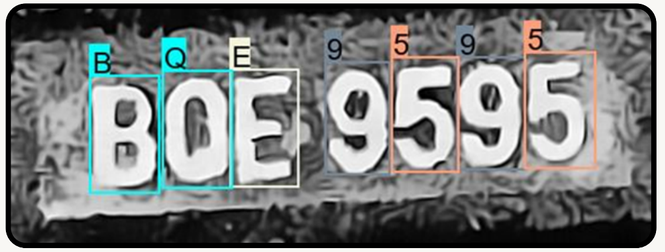
Method 2 outperforms Method 1 and Method 3 in ALPR system enhancement.

Real Life Verification

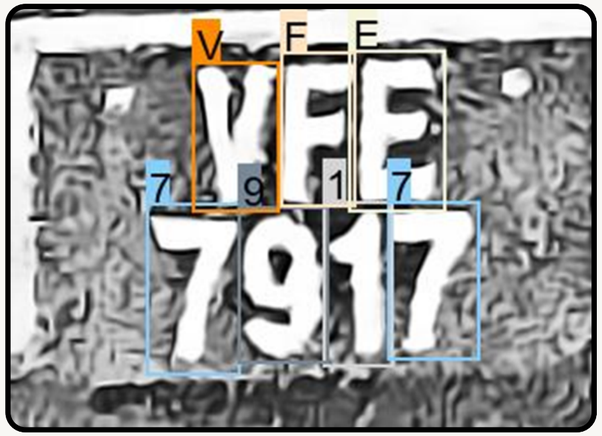
- Daytime with clear visibility
- Daytime with uneven color background
- Nighttime with normal light
- Nighttime with strong light

Daytime with clear visibility

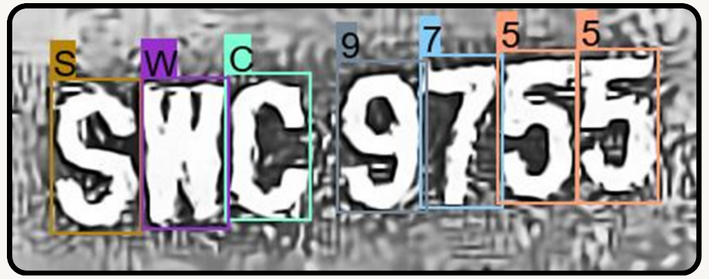
Daytime with uneven color background



Nighttime with normal light



Nighttime with strong light



Comparison within various scenarios

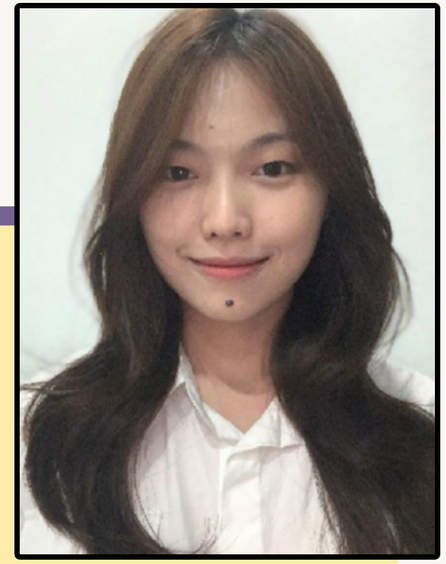
- The proposed model, implemented with Method 2, achieved expected results.
- Analysis of ALPR system performance highlights the impact of surrounding environments on license plate recognition accuracy.
- Accuracy can be improved in scenarios 3 and 4, which are detected during nighttime.
- Overall, Method 2 was able to handle various scenarios.

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Environment	Daytime with clear visibility	Daytime with uneven colour background	Nighttime with Normal light	Nighttime with strong light
Challenge Level	Low	Low	Medium	High
Is License Plate Detected?	Yes	Yes	Yes	Yes
LP Detection Result	100%	100%	100%	100%
Character Recognition Result	100%	100%	80%	100%
Each Character Recognition Result	100%	90%	70%	50%
Can the proposed model handle this scenario?	Yes	Yes	Yes	Yes

Conclusion

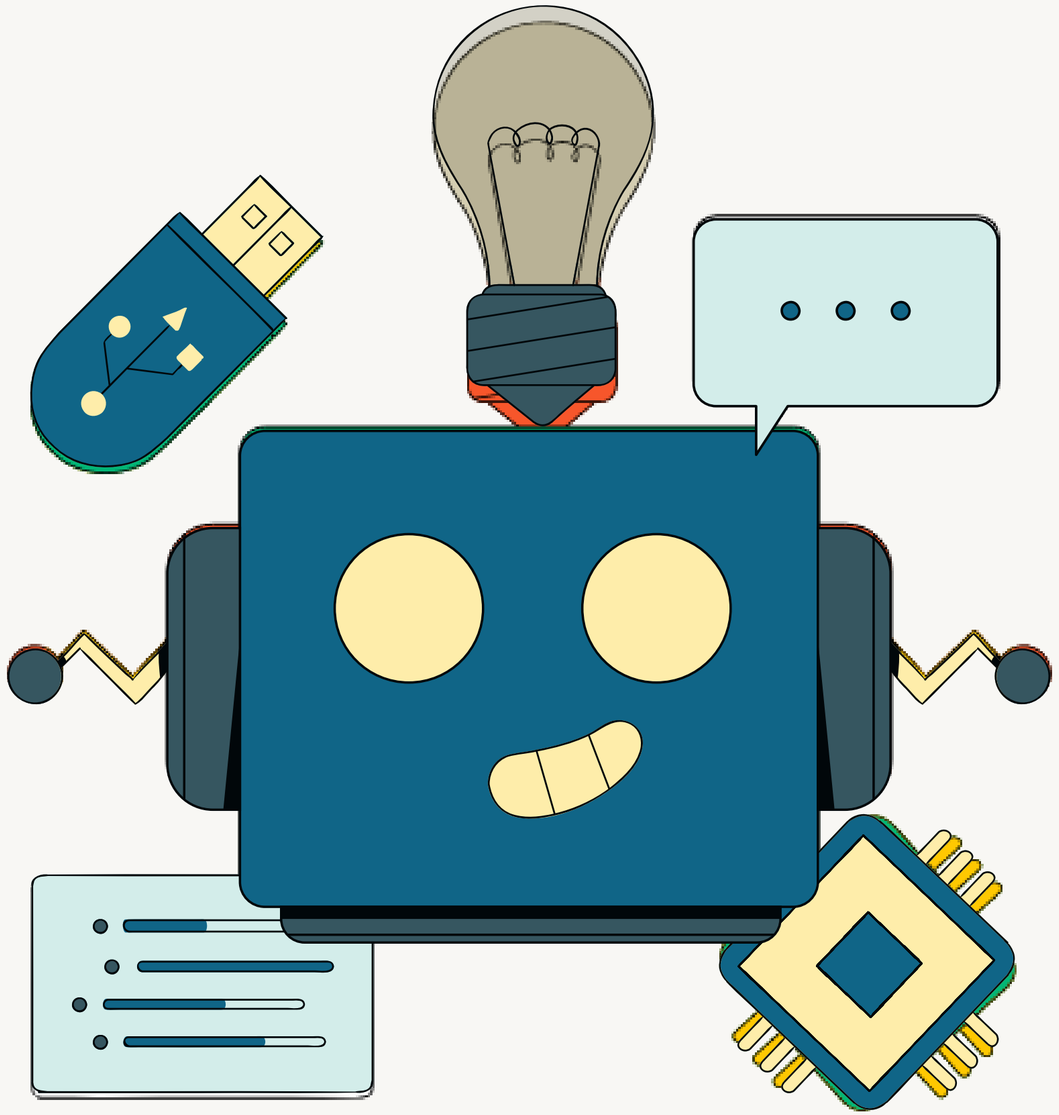
- This project successfully developed an adaptive image processing technique flow to optimize the ALPR system.
- Various image processing techniques were analysed and compared to enhance license plate recognition.
- Evaluation the ALPR performance across four diverse types of scenarios.
- Future research could explore other neural network architectures or investigate new image processing techniques method ways to improve the robustness of ALPR system.

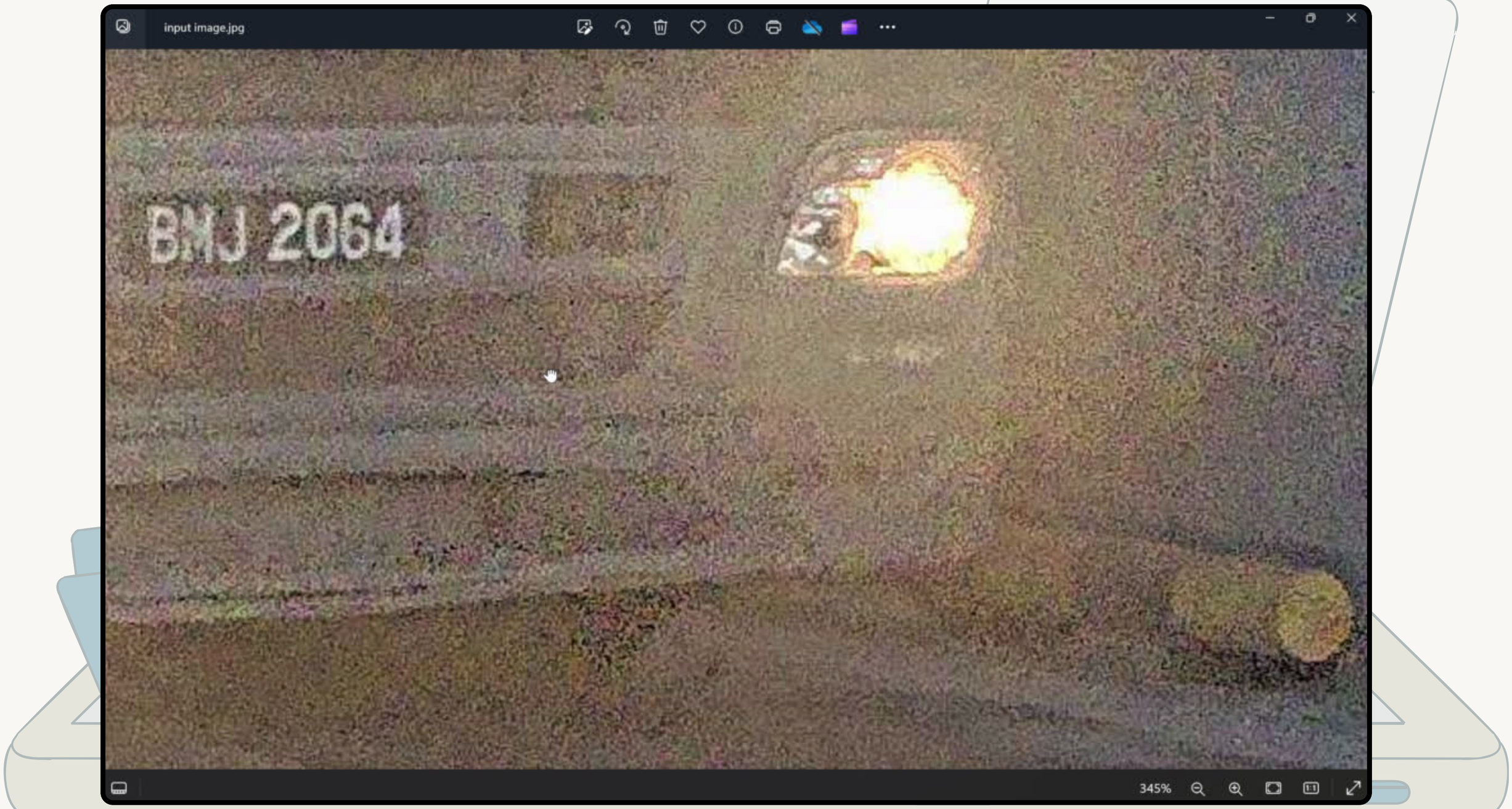
Testimonial



Throughout my Industry-based FYP, I've demonstrated an advanced understanding of image processing algorithms and proficiency in optimizing ALPR performance through adaptive techniques. I've consistently identified and addressed challenges in ALPR accuracy and efficiency, collaborating with peers to devise innovative solutions. Engaging in collaborative problem-solving, I've fostered teamwork and achieved significant personal and professional growth through project challenges.

Thank you




input image.jpg
BMJ 2064
345%