



REPORT OF MASTER THESIS REVISION

Full name: Nguyễn Thị Hoà An

Class: MICE3A

Cohort: 2024.. – 2026..

Date of thesis defense: 11/07/2026

Thesis title:

+ Tiếng Việt: Nhận dạng phương tiện trong các vùng quan tâm của hệ thống camera giám sát

+ Tiếng Anh: Vehicle Recognition in Regions of Interest within Surveillance Camera Systems

Supervisor:

I hereby declare that I have revised my master thesis as required by Master Thesis

Examination Committee:



Point	Requirements by the Committee	Detailed revisions	Pages
1	Clearly state the contribution and the research gap of the thesis (Committee resolution).	Added a new Section 1.5 “Research Gap and Contributions”, stating the research gap explicitly and listing four numbered contributions of the thesis.	9
2	Correct the inconsistent dataset size (900 images vs. 2,000 images divided into 1,600/200/200) throughout the thesis.	The dataset description was unified as nearly 900 images with an 80:10:10 train/validation/test split, consistently in the Abstract, Sections 4.1.1 and 4.1.3, and the Conclusion; all inconsistent figures (2,000/1,600/200/200) were removed.	3, 26–27, 29–30, 50
3	Provide a detailed data description: number of vehicles, annotated keypoints, camera locations, daytime/nighttime distribution, and possible overlap between consecutive frames.	Added detailed statistics to Section 4.1.1: 4,800 annotated vehicle instances; 19,200 labeled wheel keypoints, of which 12,291 (64.0%) are directly visible; two main camera sites BNS_001 (51.8%) and BNS_002 (43.6%) covering 95.4% of the data; 77.6% daytime and 22.4% nighttime (infrared) scenes; the collection procedure and duplicate-frame filtering are described.	26–27

4	Ensure that the independence of the training, validation, and test sets can be assessed.	Described the frame-sampling procedure (video recorded over approximately 10 days, frame extraction, near-duplicate filtering performed before partitioning) and added an explicit independence statement in Section 4.1.3.	29–30
5	Provide classification indicators for the final ROI occupancy decision over the whole test set: Accuracy, Precision, Recall, F1-score, false-occupancy rate, and missed-occupancy rate.	Added a new Section 4.3.4 evaluating the complete pipeline on all 90 test images (225 image×ROI samples from two camera sites): Accuracy 97.78%, Precision 95.18%, Recall 98.75%, F1 96.93%, false-occupancy 2.76%, missed-occupancy 1.25%, with a failure-mode analysis of all five errors; the results were also added to the Abstract and the Conclusion.	47–50 (also 3, 50)
6	Present repeated experiments, statistical variations, or confidence intervals.	Added a 95% Wilson confidence interval for the final Accuracy (94.9%–99.0%) and a sensitivity analysis of the decision thresholds (confidence and IoU), with a note that YOLO inference is deterministic for fixed weights.	48
7	Explain how the keypoint mAP50 of approximately 55% affects the final binary ROI occupancy decision (Question 2).	Added an explanation in Section 4.3.4: mAP50 penalizes small per-keypoint deviations, whereas the occupancy decision depends only on the polygon–ROI intersection ratio; the missing-keypoint reconstruction absorbs the dominant error mode, as confirmed by the 97.78% final accuracy.	49
8	Strengthen the review of closely related work on parking-space occupancy detection, ROI-based vehicle localization, keypoint-based representation, and segmentation-based approaches.	Added a new Section “Related Work” reviewing four families of related approaches (patch-classification parking occupancy, ROI with axis-aligned/oriented bounding boxes, instance segmentation, keypoint-based detection) and comparing each with the proposed method, supported by five new peer-reviewed references [12]–[16].	21–22
9	Reduce the overly broad description of general computer-vision concepts and early R-CNN/YOLO versions in the literature review.	Condensed Sections 2.1–2.3 and the R-CNN, Fast R-CNN, YOLOv1, and YOLOv3 subsections to roughly half of their original length, keeping all figures and shifting the focus to YOLOv8/YOLOv11-Pose and the new Related Work section.	10–16
10	Reconcile the reported processing times: requirement below 100 ms vs. about 0.24 s in the demonstration vs. about 96.3 ms in the conclusion.	Clarified in Section 3.1.2 that the requirement applies to model inference; the Demo section now explains that 0.24 s is the end-to-end time (including image loading, visualization, and JSON export) while 96.3 ms is the pure inference time averaged over the test set on	23, 44, 50

		CPU-only hardware; consistent wording was added to the Conclusion.	
11	Include more challenging demonstration cases, such as adjacent vehicles, partially occupied spaces, and severe occlusion.	Added Figure 32 showing a crowded scene at site BNS_001 in which more than ten adjacent, partially occluded vehicles are detected simultaneously with bounding boxes and wheel keypoints; additional hard cases (boundary-straddling vehicle, oversized truck spanning two ROIs, night-time infrared glare) are analyzed in Section 4.3.4.	46–48
12	Include at least one alternative approach in the evaluation, such as instance segmentation, oriented bounding-box detection, or another keypoint-estimation model.	Alternative approaches (Mask R-CNN, RoI Transformer, YOLO-Pose) were analyzed qualitatively in the Related Work section together with the reasons for the chosen design; a full experimental comparison is acknowledged as a limitation and proposed as future work in the Conclusion.	21–22, 51
13	Clarify whether and how the waste-detection publication listed in Section 6 contributes to the thesis.	The publication is not directly related to the thesis topic; therefore, the Publication section was removed from the thesis and the Table of Contents was updated accordingly.	—

**Students are required to send a soft copy of the master thesis with highlighted revised points and a soft copy of original master thesis via email (postgraduate@isvnu.vn).*

Hanoi, 17/7/2026

Supervisor
(sign with full name)


Phạm Đức Tân

Student
(sign with full name)


Nguyễn Thị Hòa An

CHAIR OF THE COMMITTEE


Nguyễn Quang Thuận