Domain Adaptation pipeline for Brick Kiln Detection using Unpaired image to image Translation

Umang Shikarvar
23110301@iitgn.ac.in

Nipun Batra
nipun.batra@iitgn.ac.in

Rishabh Mondal
rishabh.mondal@iitgn.ac.in

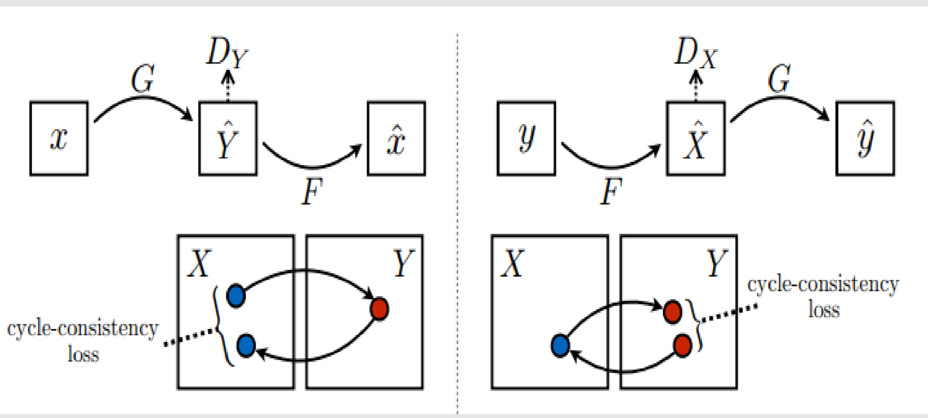
Sustainability Lab
AI and Sensing for Sustainability

Motivation

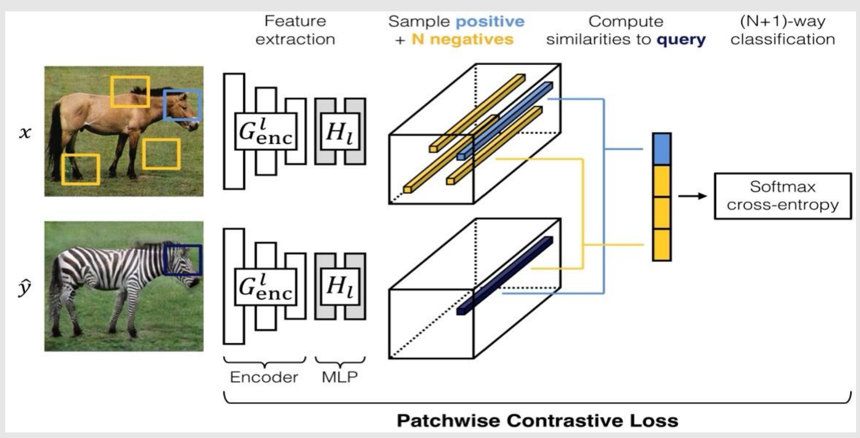
- India hosts over 150,000 brick kilns, which contribute significantly to air pollution.
- Detecting them is vital for environmental monitoring, regulation, and improving labour conditions.
- However, object detectors like YOLO, while achieving >80% accuracy within a region, suffer a 40–50% performance drop when applied to a different region due to domain shift.
- Variations in landscape, kiln appearance, and image conditions hinder generalization, making region-independent detection a key challenge.

Unpaired image to image translation

Cycle consistent Generative Adverserial Network



Contrastive learning for Unpaired image to image Translation



Source (285.91)

Target

CycleGAN (192.25)

CUT(244.29)

Brick Kiln Placement on Translated Images

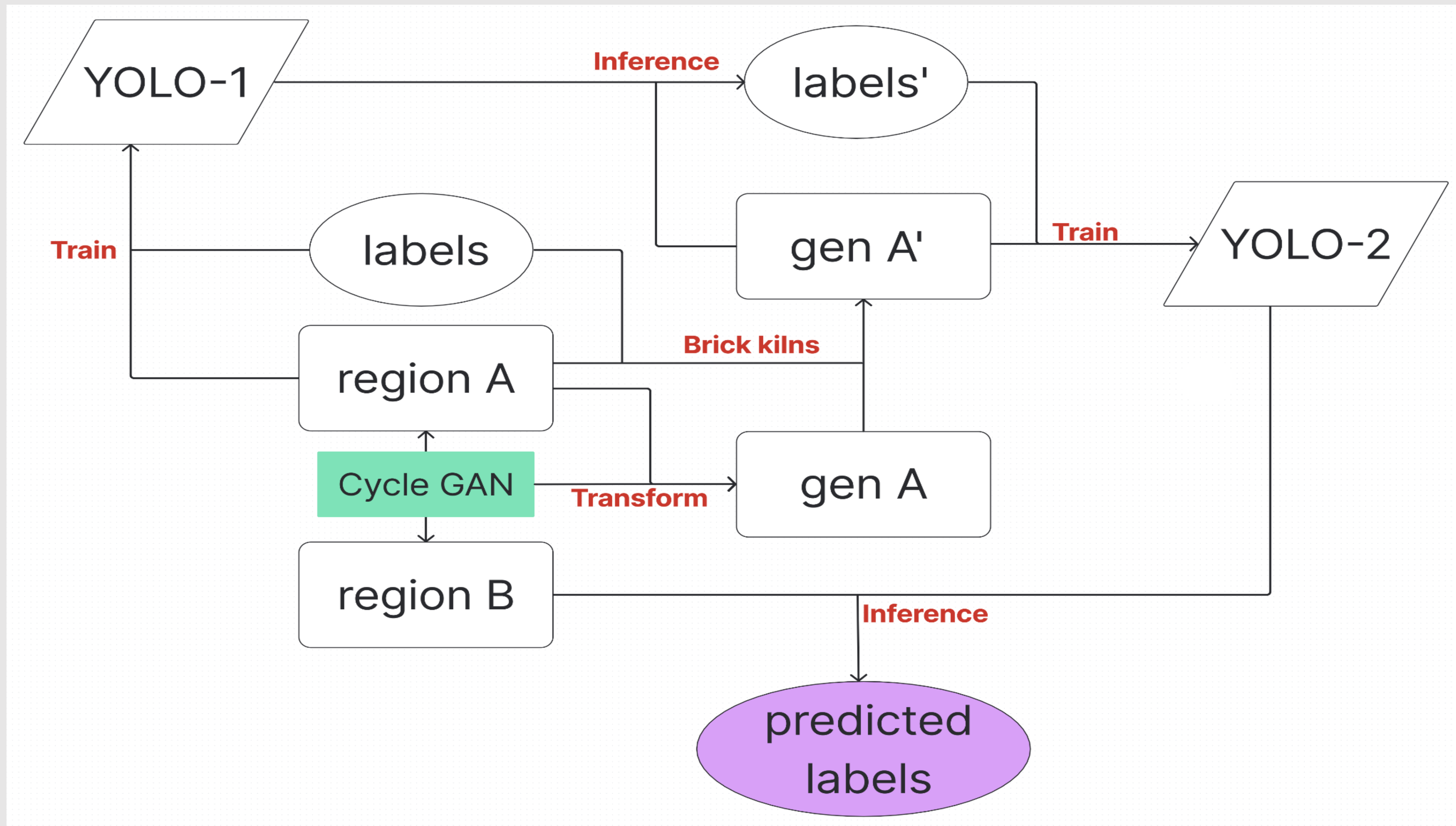
Original

Generated

Generated image with brick kilns from source

Domain Adaptation Pipeline

- Generate target-style images from source using unpaired image-to-image translation.
- Paste source brick kilns onto translated images using original bounding boxes.
- Use a pretrained YOLO model to refine labels on the translated images.
- Train a new YOLO model on these images and predict on the target domain.



Results

Train Source	Target	mAP
Delhi	WB	0.506
Delhi(CG)	WB	**0.578**
Delhi(CUT)	WB	0.535
WB	Delhi	0.605
WB(CG)	Delhi	0.638
WB(CUT)	Delhi	**0.654**

Conclusion & Future work

- Unsupervised translation models (CycleGAN, CUT) help address domain shift, improving cross-region YOLO performance.
- Preserving object features and applying relabeling ensures accurate localization post-translation.
- Future work includes exploring diffusion models and spatial attention for better translation and detection.

References

- *J. -Y. Zhu, T. Park, P. Isola and A. A. Efros, "Unpaired Image-to-Image Translation Using Cycle-Consistent Adversarial Networks," 2017 IEEE International Conference on Computer Vision (ICCV), Venice, Italy, 2017, pp. 2242-2251, doi: 10.1109/ICCV.2017.244.*
- *T. Park, A. A. Efros, R. Zhang, and J.-Y. Zhu, "Contrastive Learning for Unpaired Image-to-Image Translation," pp. 319–345, Aug. 2020, doi: https://doi.org/10.1007/978-3-030-58545-7_19.*