Enhancing Change Detection in "The Change You Want to See"

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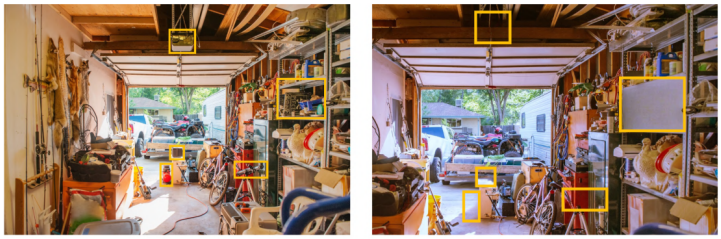

Figure 1. In this image pair, 5 out of 6 differences are shown using yellow boxes. Can you spot the remaining one? Our model can.

Introduction and Overview

The Change You Want to See[Ragav Sachdeva, Andrew Zisserman] [WACV 2023] presents a novel approach to change detection in image pairs by leveraging a U-Net-based architecture with a ResNet50 backbone. This model focuses on identifying and localizing changes between two images, an essential task for applications in surveillance, environmental monitoring, and urban planning. The architecture employs a co-attention mechanism to effectively learn and highlight differences between the compared images, demonstrating promising results in accurately detecting change regions. The dataset for the task has been provided in this paper itself. We chose this paper due to its unique niche yet an open problem to try a lot of experiments and ablations with the model.

Objectives

This project proposal aims to build upon the foundational work of *"The Change You Want to See"* by implementing a series of ablation studies and architectural improvements. The project is expected to deliver an enhanced change detection model with better performance in terms of the Average Precision score computed by the paper and a more robust model towards noise and variance in the input.

Proposed Ablation Studies & Architectural Improvements

- **Integration of Advanced Backbone Architectures & Variations:** Implement and evaluate the efficacy of cutting-edge backbone architectures such as Vision Transformers, Swin Transformers, MViTs, etc., pre-trained on similar tasks like object detection, which have shown remarkable success in various vision tasks due to their ability to capture global dependencies. [Reference Paper]
- **Enhanced Attention Mechanisms:** Incorporate more sophisticated attention mechanisms to improve the model's ability to focus on relevant features for change detection, potentially increasing accuracy and sensitivity to subtle changes, by exploring different attention mechanisms, including self-attention, multi-head attention, Global-local, spatial-channel attention to evaluate their effect on the co-attention model. [Reference Paper]
- **Hyper-parameter Tuning:** Playing with different model parameters to determine the optimal configuration of model for balancing performance with computational efficiency using tools like Sweeps in WandB.
- **Advanced Pre-processing and Feature Enhancement:** Pre-processing steps and feature enhancement methods, such as spatio-temporal feature enhancement, could be critical for improving model performance. These techniques can help in reducing noise and enhancing relevant features for change detection, especially in complex scenes where traditional methods might lead to pseudo-changes. [Reference Paper]
- **Try to integrate PINNs in the architecture:** To improve the model architecture using Physics Informed Neural Networks (PINNs), we will try to integrate domain-specific knowledge from computer vision directly into the neural network training process (like homographies, skew, fundamental matrices etc). This involves modifying the loss function to include terms that enforce the model's predictions to adhere these known laws and equations at hand. [Reference Paper]
- **Multi-Task Learning Framework:** Explore a multi-task learning approach that integrates auxiliary tasks (e.g., semantic segmentation, object detection) to enrich feature representations and improve overall model performance.
- **Improving the 3D paper as well:** If we are successful in finding better ablations and architecutural improvements in this paper, we will try to use and implement the same chain of thought to improve the other similar paper called The Change You Want to See (Now in 3D)

Access to Compute

- **Hardik Mittal:** Access to Ada with CVIT & research account along with another NVIDIA-RTX4090 (subject to availability)
- **Amey Choudhary:** Access to Ada with research account