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# AI&ML Assignment Task

**Assignment:** Ad Image Insertion in Video with Occlusion Handling

**Introduction**
In the field of computer vision, occlusion handling refers to the process of effectively managing visual obstructions within a scene to maintain the integrity of digital overlays or inserted imagery. Occlusions occur when objects or movements obstruct the view of certain areas in an image or video, potentially interfering with the seamless integration of additional content. Our task is to develop a robust computer vision solution capable of intelligently addressing occlusions while inserting a specified advertisement image into a given video. This involves strategically managing occluded regions to ensure the advertisement remains visually appealing and unobstructed throughout the insertion process.

**Objective:** The goal of this assignment is to develop a computer vision solution that inserts a specified advertisement image into a given video, ensuring graceful handling of occlusions during the insertion process.

**Scope:** Develop an algorithm aimed at inserting a provided advertisement image into a video, paying attention to potential occlusions caused by objects or movements in the scene. Demonstrate a strategic approach to handle occlusions during the insertion process and document it.

**Methodology**
1. **Load Input Files:** Load the video file and advertisement image from their respective paths. Use OpenCV to read the files into memory.
2. **Preprocessing:** Resize the video frames and advertisement image to match their dimensions. Convert the advertisement image to grayscale for background removal.
3. **Initialization:** Initialize variables and parameters for occlusion handling.
   Set up counters to track progress through the video frames.
4. **Occlusion Handling:** Iterate over each frame of the video. Remove the background of the advertisement image to isolate the foreground object. Apply strategies to handle occlusions, such as adjusting placement based on detected occluded regions.
5. **Advertisement Insertion:** Blend the advertisement image with the video frame to create the final composite image. Use alpha blending for smooth integration with the background.
6. **Display and Output:** Display the composite image for visualization and real-time feedback. Write the composite image to an output video file if specified.
7. **Termination:** Check for user input to exit the loop. Release resources such as file handles and memory allocations. Terminate the algorithm.

**Flow of Algorithm to Ad Image Insertion in Video with Occlusion Handling:**
1. **Start:** Start of the process.
2. **Load Video:** Load the input video.

3. **Load Advertisement Image:** Load the advertisement image.
4. **Preprocessing:** Convert the advertisement image to grayscale. Apply thresholding to create a binary mask for background removal.
5. **Initialize Variables:** Set up variables for processing frames.
6. **Loop Over Frames:** Read each frame from the video. Resize the frame and the advertisement image if necessary.
7. **Background Removal**: Apply the binary mask to remove the background from the advertisement image.
8. **Occlusion Handling:** Determine occlusion-free regions in the video frame. Overlay the advertisement image onto these regions while preserving the underlying content.
9. **Blend Images:** Blend the advertisement image with the video frame using bitwise operations.
10. **Display Frame:** Display the frame with the inserted advertisement.
11. **Write Frame:** Write the frame to the output video if desired.
12. **Check for Key Press:** Check for the 'q' key to exit the loop.
13. **End of Video:** Check if there are more frames in the video. If not, proceed to the next step.
14. **Release Resources:** Release video capture and writer objects.
15. **End:** End of the process.

## Strategies Employed

- **Background Removal:**
  The background removal technique is employed to isolate the advertisement image from its background, ensuring that only the relevant content is retained.
  The process involves converting the advertisement image to grayscale and applying thresholding to create a binary mask for background removal.

- **Occlusion Handling:**
  To handle occlusions gracefully, a strategy is devised to blend the advertisement image with the video frame seamlessly.
  This involves determining occlusion-free regions in the video frame and overlaying the advertisement image onto these regions while preserving the underlying content.

## Challenges Faced

Identification of challenges encountered during implementation:

- Adjusting parameters for optimal background removal and occlusion handling.
- Ensuring smooth integration of the advertisement image with varying video content and occlusion patterns.

## Conclusion

This task provided valuable insights into occlusion handling in computer vision. By developing a solution to insert advertisement images into videos while addressing occlusions, I deepened my understanding of image processing techniques and their practical applications.