# REPORT: SD TO HD Video Conversion using Diffusion Model

## Problem Statement:

To develop a prototype of a video conversion process that can convert SD videos to HD videos using diffusion (image to image, Inpainting) type models, while preserving the context of the video and being efficient.

## Design:

The tool comprises several key components:

1. **Frame Extraction:** Frames are extracted from the input video using OpenCV (cv2), ensuring each frame is captured for subsequent processing.
2. **Frame Padding:** Each extracted frame is resized and padded to a target resolution (1280x720) using OpenCV. This step ensures consistency in frame dimensions for inpainting.
3. **Diffusion Inpainting:** The heart of the tool lies in the diffusion inpainting process, facilitated by the AutoPipelineForInpainting from the diffusers library. This model is pretrained on the "stable-diffusion-inpainting" model available via RunwayML. It supports torch.float16 precision and utilizes CPU offloading for efficient computation.
4. **Frame Assembly:** After inpainting, frames are assembled back into a video sequence. The tool provides flexibility in adjusting the frames per second (fps) for the output video.

## Implementation:

1. **Frame Extraction and Padding:** Frames are extracted from SD Video and appended to a list. Each frame undergoes resizing and padding to fit the target resolution (1280, 720). The padding ensures that frames maintain aspect ratio and are centered within the target dimensions.

2. **Diffusion Inpainting:** The diffusion model using AutoPipelineForInpainting, configured for torch.float16 precision to optimize performance. It supports inpainting operations on frames resized to 512x512 pixels. The inpainting process involves:

- Resizing the frame and its corresponding mask to 512x512.
- Initiating inpainting using the model pipeline.
- Resizing the resulting inpainted frame back to its original dimensions.

3. **Frame Assembly to Video:** Inpainted frames are collected into array, which are subsequently assembled into a HD Video as final Output. The output video is encoded with the mp4v codec.

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