# Animation from Generative Keyframes

Wenhe Wang
Simon Fraser University, CMPT 742

## Abstract

This project aims to generate a series of animations from keyframes. These keyframes are obtained through generative models of images and then transformed into intermediate frames to realize an animation effect. The approach leverages generative models and state-of-the-art deep learning techniques to ensure smooth and consistent animations.

## 1 Introduction

Animating objects based on single images or a few keyframes is a challenging problem with wide-ranging applications in the entertainment industry, virtual reality, and digital arts. Achieving smooth transitions, accurate depictions, maintaining temporal consistency, and ensuring user-friendliness is crucial. This project seeks to address these challenges and offer a reliable solution [2, 3].

## 2 Input and Output Instance

**Input:** 9 * 3 * 3 * 3 keyframes of a cat, where 9 means the cat's positions in upper-left, upper-middle, upper-right, middle-left, middle, middle-right, bottom-left, bottom-middle, bottom-right in the image, and 3 means the images for different places of the cat's shaking eyes, ears, and tails.


Figure 1: An example of a black cat in different shapes and places [7]

**Output:** An animation with the cat moving in response to an external stimulus (e.g., a mouse).

# 3 Methodology

The project will:

- Use generative models of images such as Stable Diffusion and Midjourney to produce these keyframes [2, 3].
- Ensure temporal consistency between frames using methods like optical flow estimation, and depth-aware frame interpolation, like DAIN and SuperSloMo [4, 5].
- Implement a state machine to determine the cat's actions based on the mouse's location.

# 4 Related Work

Generative models have been widely used for image-generation tasks. Research such as [2] and [3] have delved into producing high-quality images from models. Frame interpolation and animation generation using DNNs have been explored in works like [4], [5], and [6]. Applications like "Animated Drawings" [1] can generate 32 animated action templates by uploading images, framing targets, extracting keystrokes, tagging people, and picking action templates.

# 5 Timeline and Milestones

- **Oct 2023:** Literature review, setup, data collection, and initial model exploration.
- **Nov 2023:** Keyframes generation and diffusion technique application.
- **Dec 2023:** Intermediate frame generation and initial animation. Refinement, temporal consistency checks, and final animations.
- **Finish:** Have a complete interactive dynamic animation.

# 6 Evaluation

- **Quantitative Evaluation:** Use metrics such as MSE, PSNR, SSIM, and temporal consistency metrics.
- **Qualitative Evaluation:** Visual inspections, user studies, and comparative analysis.
- **Testing:** Real-world data tests for diverse scenarios.
- **Computational Efficiency:** Measure processing speed and memory usage.
- **Robustness:** Evaluate performance across various image types and conditions.

# References

[1] Meta Inc., CMU Graphics Motion Capture Lab, and Mixamo. *Animated Drawings*. Retrieved at: https://sketch.metademolab.com/canvas (2023)

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[3] Midjourney, Inc. *Midjourney*. Retrieved at: https://www.midjourney.com (2022)

[4] Bao W., Lai W., et al. *Depth-Aware Video Frame Interpolation*. IEEE Conference on Computer Vision and Pattern Recognition, Long Beach, CVPR (2019)

[5] Jiang H., Sun D., et al. *Super SloMo: High Quality Estimation of Multiple Intermediate Frames for Video Interpolation*. IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI) and ICCP (2020)

[6] joeyguo. *gka*. Retrieved at: https://github.com/gkajs/gka (2017)

[7] Sveta Aho. *Black cats set vector image*. VectorStock. Retrieved at: https://www.vectorstock.com/royalty-free-vector/black-cats-set-vector-10542397