4 Automatic and Personalized Tunnel Book Generation from Photographs

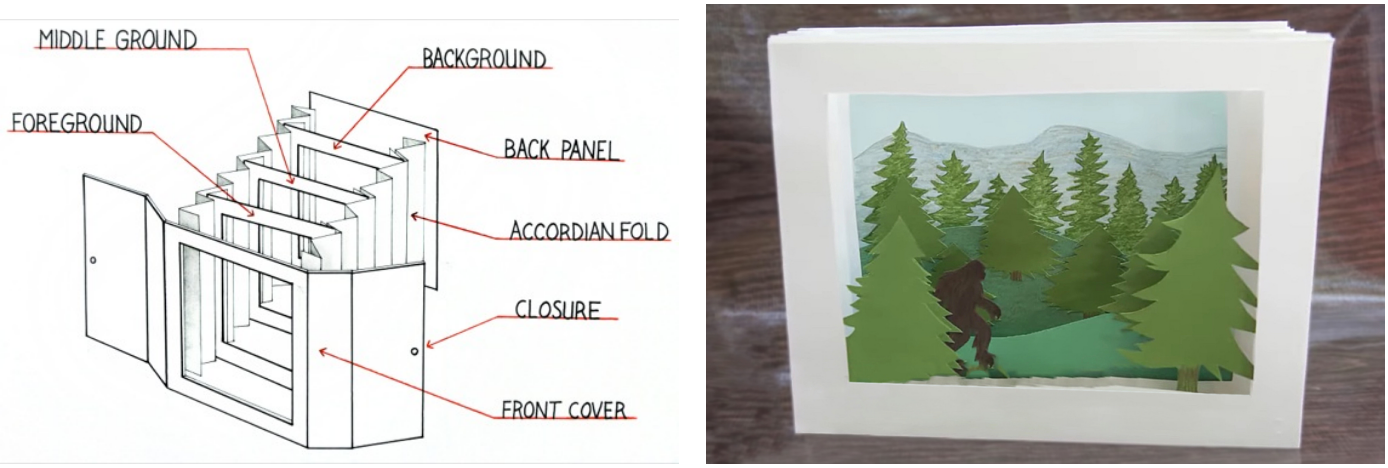

Fig. 4: A tunnel book is a three-dimensional, layered piece of art that is created by making a "tunnel" ("accordion") structure out of a series of cut or stacked layers. It incorporates a perspective view, creating the illusion of depth and space when the book is opened and the layers are expanded. Image sources: left and right.

Description: The goal of this project is to automate the process of creating a tunnel book by suggesting optimal cutting positions based on photograph content. We aim to define a "tunnel-bookiness" metric, assessing the degree to which an image lends itself to this artistic form, considering factors like perspective, layering, and visual appeal. The project aims to integrate image processing and machine learning techniques (e.g., depth estimation [2], inpainting [1]) to assist users/artists in creating tunnel books from still 2D photographs.

Tasks: Perform a literature review. Implement a baseline method to suggest the cut/layers from a single image/photograph. Quantify the practical feasibility of suggested layers/cut (considering physical constraints such as object positioning, absence of floating objects, how much the suggested cut can hold vertically, etc). Assess the deviation/distortion between the suggested layered depth from the cuts and the estimated depth. Define and quantify other physical constraints of a tunnel book numerically from the suggested cut. Introduce a "tunnel-bookiness" metric indicating whether an image is suitable for the tunnel book form of art. Formalize the problem of automatic cut suggestion as an optimization problem, aiming to minimize constraints (e.g., the practicality of the cut, and distortion between the original depth and the one resulting from the cut), and improve the baseline method.

Prerequesites: Basics of Optimization. Basics of Python programming. Familiarity with image processing concepts.

Learning objectives: Optimization. Computational aesthetics / Computational art, Single-image depth estimation.
Deliverables: Code, well cleaned up and easily reproducible. Written Report, explaining the literature and steps taken for the project.
Max 1 team
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References

1. Andreas Lugmayr, Martin Danelljan, Andres Romero, Fisher Yu, Radu Timofte, and Luc Van Gool. Repaint: Inpainting using denoising diffusion probabilistic models. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, pages 11461–11471, 2022.
2. René Ranftl, Katrin Lasinger, David Hafner, Konrad Schindler, and Vladlen Koltun. Towards robust monocular depth estimation: Mixing datasets for zero-shot cross-dataset transfer. *IEEE transactions on pattern analysis and machine intelligence*, 44(3):1623–1637, 2020.