Feature-based Image Stitching Benchmark

Us.

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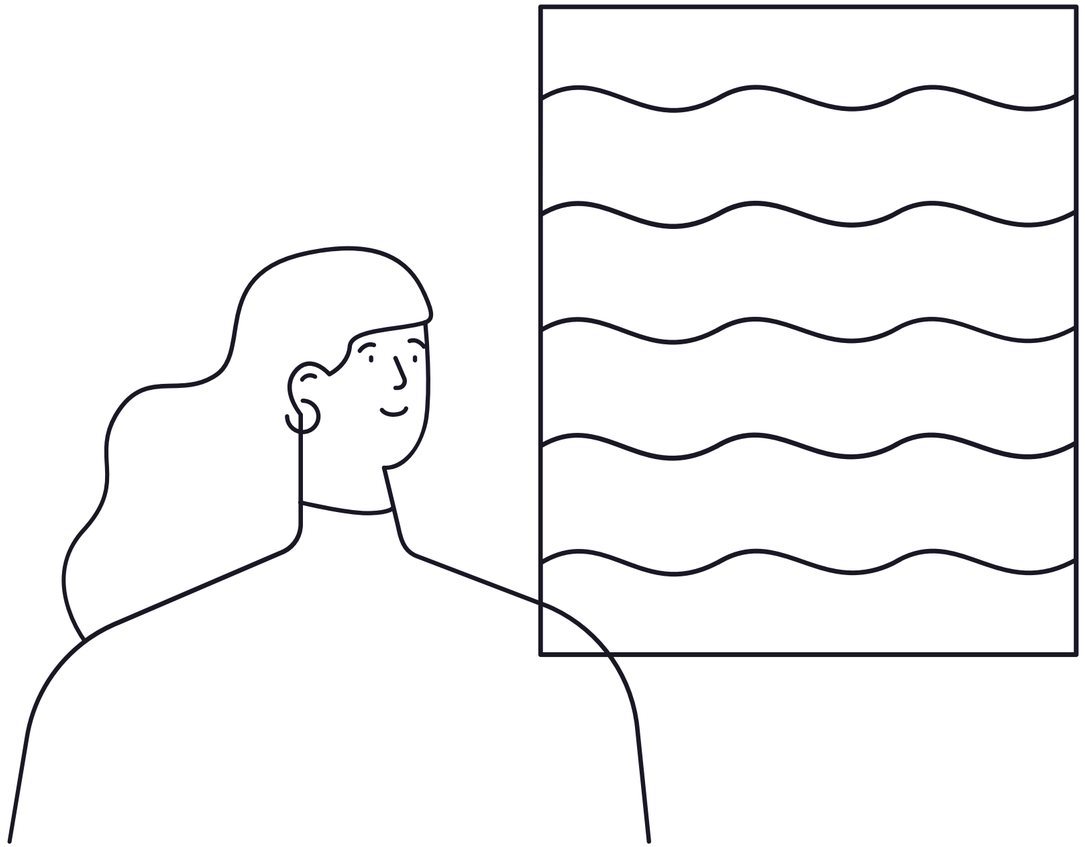


Problem statement

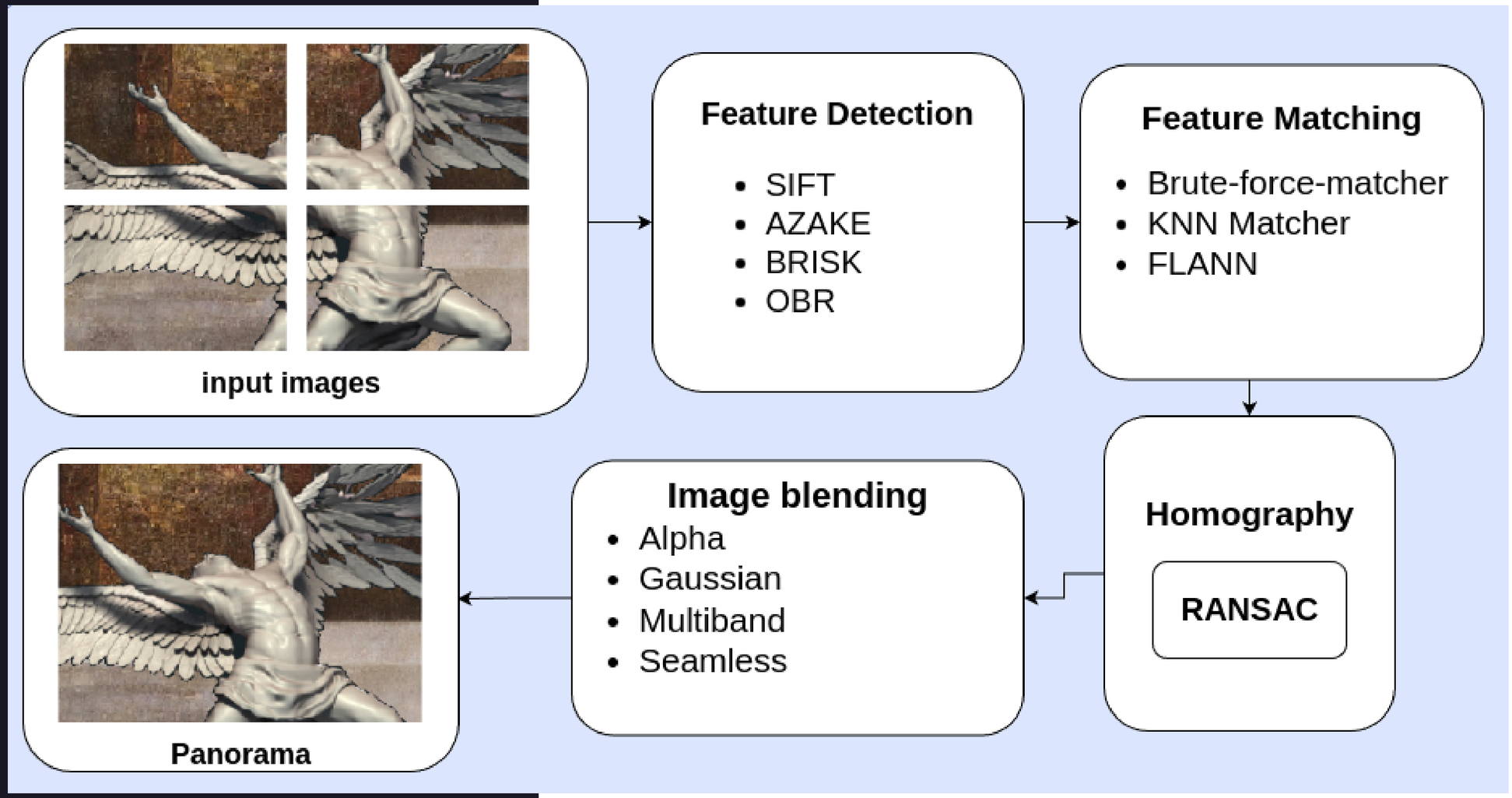
Document mosaicing. Image stabilization. High-resolution photomosaics in digital maps and satellite imagery.

Major issues to deal with are the presence of parallax, lens distortion, scene motion, exposure differences.

OUR DATASET

- Images taken from different viewpoints, perspectives, illumination, rotation, devices
- 49 scenes in total
- digital and real images with varying amounts of features
- total 261 images to be stitched (5.32 images per scene on average)

OUR PIPELINE



FEATURE DETECTION

SIFT (Scale-Invariant Feature Transform) is a feature detection algorithm that uses a scale-space rep-
resentation of the image to detect and describe key-
points.

AKAZE (Accelerated-KAZE) is an extension of KAZE algorithm and is designed to be computation-
ally efficient and robust to changes in scale and view-
point.

BRISK (Binary Robust Invariant Scalable Keypoints) is a binary descriptor that uses a scale-
space pyramid to extract keypoints and produces compact binary descriptor.

ORB uses a multi-scale pyramid approach for keypoint detection and descriptor computation. It detects more features than required, therefore though being fast in speed its accuracy certainly drops

FEATURE MATCHING

The basic idea behind ***brute force matching*** is to compare each feature in one image to every feature in the other image and find the closest match based on some distance metric.

KNN matching is a two-step process. First, the algorithm finds the K nearest neighbors of each feature descriptor. Then, it filters out the matches that are not unique

FLANN is a library that implements a collection of algorithms optimized for fast nearest neighbor search in large datasets and for high dimensional features.

GEOMETRIC TRANSFORMATION

Matched keypoints are used to estimate homography matrix. Homography estimation is a crucial step in image stitching, as it determines the transformation required to warp the images into a common coordinate system.

Given the matched feature points, the geometric transformation between the two images is estimated using a robust estimation algorithm such as Random Sample Consensus (RANSAC).

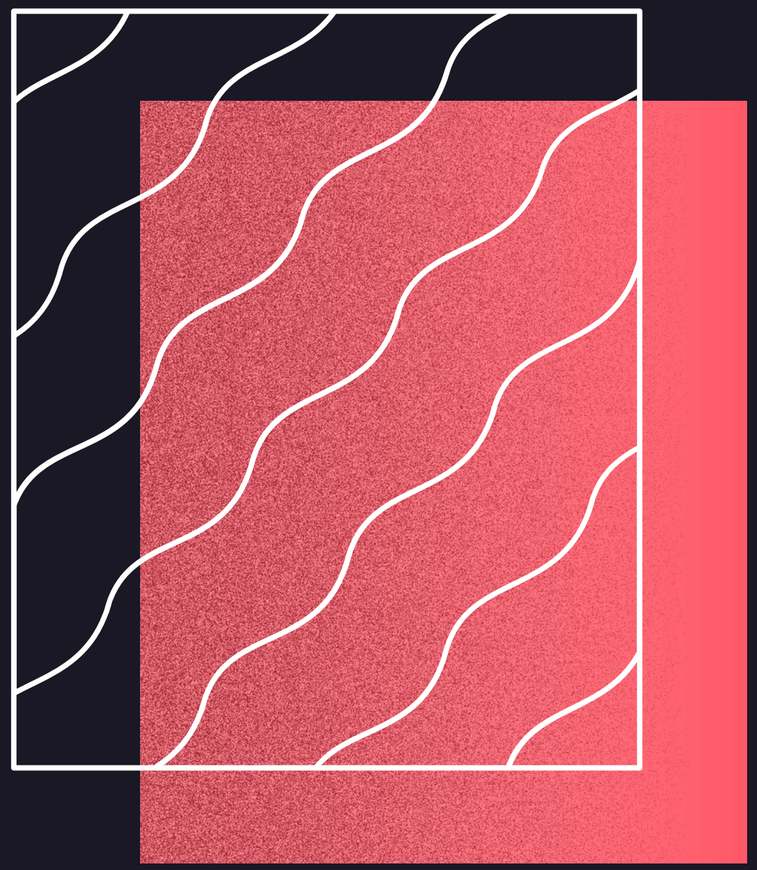


IMAGE BLENDING

Alpha blending: The degree of transparency, or alpha value, is used to blend the colors of the foreground and background images or objects in a way that creates a smooth transition between them.

Gaussian blending is the process of blending images or objects using a Gaussian distribution. In this method, a Gaussian filter is applied to each pixel, which smooths out the sharp edges and creates a softer transition between the images or objects being blended.

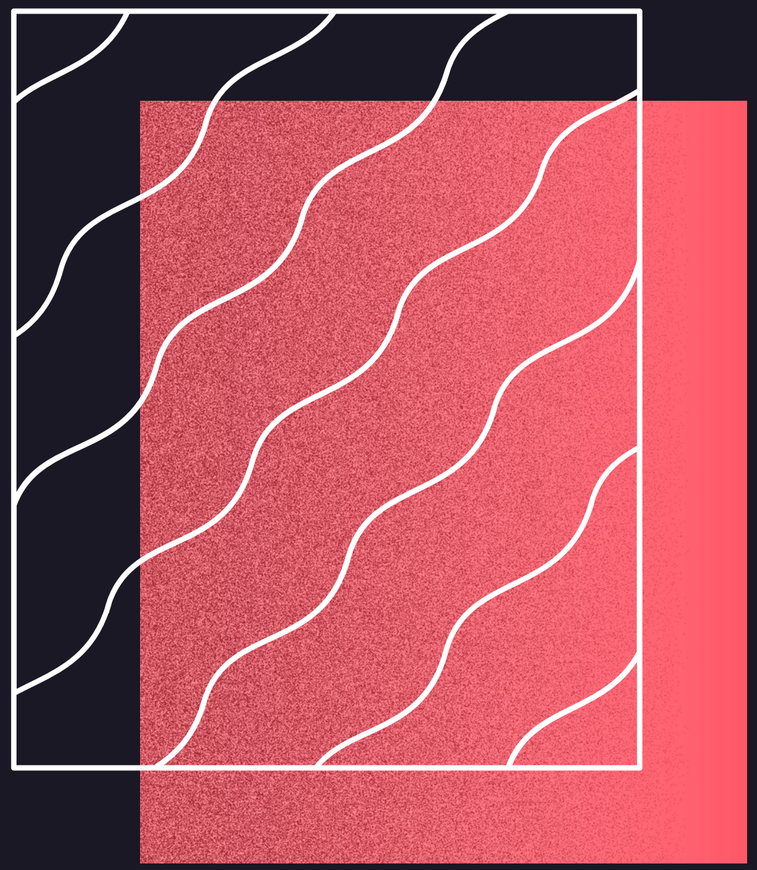


IMAGE BLENDING

Seamless blending ensures that the color of the inserted image is likewise altered so that the inserted object appears to be a natural part of the target image's surroundings.

In *multi-band blending* When coarse features are present close to boundaries, they are blended gradually across a sizable distance without distorting or otherwise impairing the finer aspects of the surrounding image.

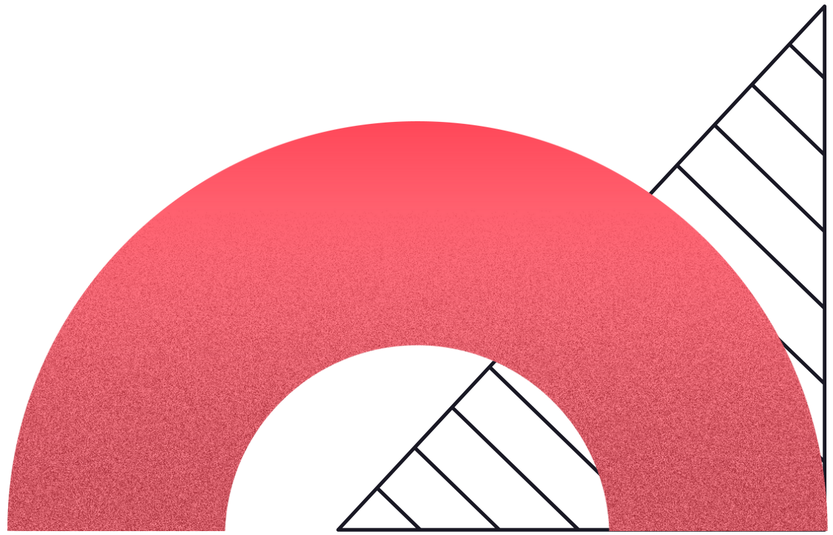
ANALYSIS

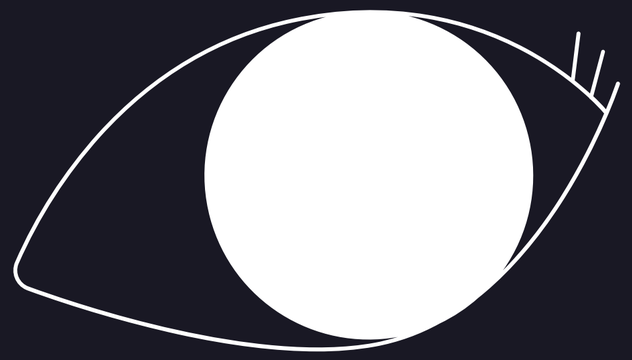
Can be qualitative or quantitative;

Quantitative measures

- Mean squared error
- Peak signal-to-noise ratio
- Structural Similarity Index
- Normalized Mutual Information

*refer to report for detailed analysis





HERE ARE SOME RESULTS

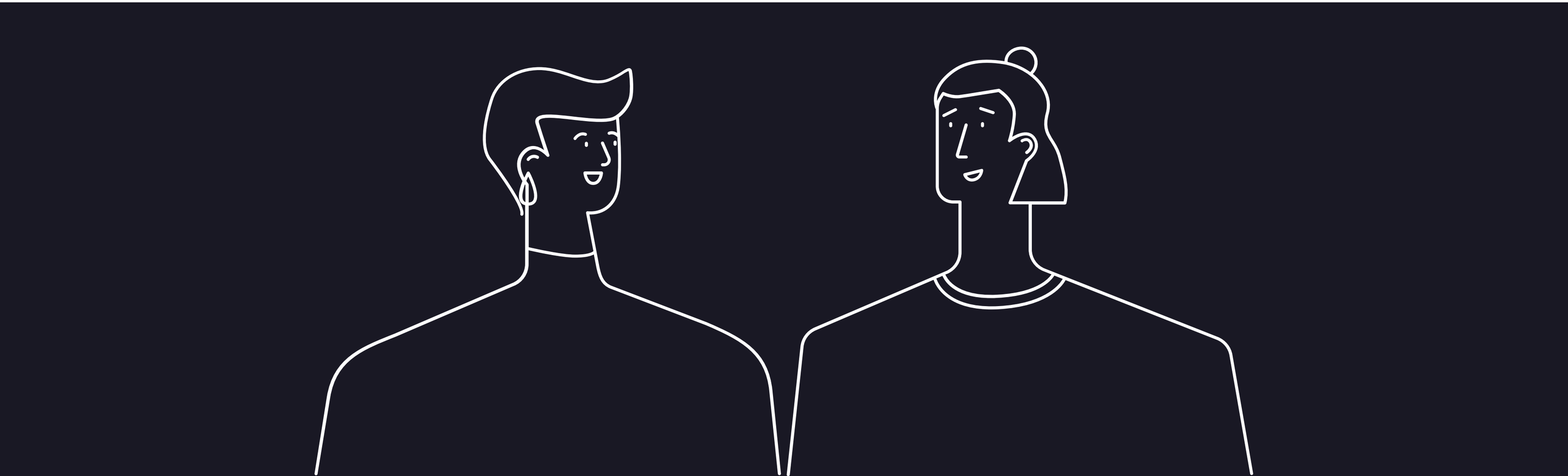
scene_12
SIFT with BFMatcher and alpha blending

scene_9
BRISK with FLANN and gaussian blending

scene_18
ORB with FLANN and multiband blending

scene_2
OpenCV- SIFT + BFMatcher

scene_17
SIFT with BFmatcher and seamless blending

scene_44
SIFT with FLANN and seamless blending

LETS SEE THE DEMO