Image and Video Stabilization Using Feature Detection and Motion Estimation

# Overview

This project implements image and video stabilization techniques using advanced feature detection, motion estimation, and homography transformation. The objective is to reduce unwanted motion and produce smoother, more stable visual content.

# Features

- \*\*Real-Time Video Stabilization\*\*: Captures live video from a camera, processes it, and outputs a stabilized video in real-time.  
- \*\*File-Based Video Stabilization\*\*: Stabilizes pre-recorded video files using the same algorithms.  
- \*\*Image Stabilization\*\*: Applies stabilization techniques to individual images to correct distortions and reduce blur.  
- \*\*Feature Detection\*\*: Utilizes ORB (Oriented FAST and Rotated BRIEF) for robust feature detection.  
- \*\*Motion Estimation\*\*: Uses feature matching between frames to estimate motion and apply necessary corrections.  
- \*\*Homography Transformation\*\*: Aligns images or video frames using homography matrices to ensure consistency and stability.

# Installation

## 1. Clone the Repository

```bash  
git clone https://github.com/username/image-video-stabilization.git  
cd image-video-stabilization  
```

## 2. Set Up the Virtual Environment

```bash  
python -m venv venv  
source venv/bin/activate # On Windows, use `venv\Scripts\activate`  
```

## 3. Install the Dependencies

```bash  
pip install -r requirements.txt  
```

# Usage

## 1. Real-Time Video Stabilization

Run the script to stabilize video from your webcam:  
```bash  
python stabilize\_video.py --source camera  
```

## 2. File-Based Video Stabilization

To stabilize a pre-recorded video file:  
```bash  
python stabilize\_video.py --source file --path /path/to/video.mp4  
```

## 3. Image Stabilization

To stabilize an image:  
```bash  
python stabilize\_image.py --path /path/to/image.jpg  
```

## 4. Parameters

You can adjust parameters such as scale, feature detection sensitivity, and more by editing the script or passing command-line arguments.

# Example Results

- \*\*Original vs Stabilized Images\*\*: Shows the effect of stabilization on sample images.  
- \*\*Before and After Videos\*\*: Demonstrates the stabilization process in real-time video footage.

# Methodologies

- \*\*Feature Detection\*\*: ORB is used to detect and describe keypoints in each frame or image.  
- \*\*Motion Estimation\*\*: Matches features between frames to estimate the camera's movement.  
- \*\*Homography Transformation\*\*: A transformation matrix is computed to warp the frames or images, correcting for detected motion.  
- \*\*Motion Smoothing\*\*: Smooths the calculated motion vectors to ensure a consistent and stable output.

# Results

The project effectively reduces unwanted motion, producing clearer and more stable images and videos, even in challenging environments.