Disparity Map

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April 10, 2025

Abstract

This report presents the implementation of disparity map estimation using stereo image pairs. The disparity map is a crucial component in stereo vision systems, allowing depth perception by analyzing the pixel differences between the left and right images. This project uses OpenCV's StereoBM (Block Matching) and StereoSGBM (Semi-Global Block Matching) algorithms for disparity computation. The report compares both methods and visualizes the output disparity maps.

1 Introduction

Stereo vision enables the estimation of depth from two images taken from slightly different viewpoints. The difference in position of an object in both images is known as *disparity*, which can be inversely related to depth. This project implements:

- Preprocessing of stereo image pairs.
- Disparity estimation using StereoBM and StereoSGBM.
- Visualization of resulting disparity maps.

2 Methodology

2.1 Loading and Preprocessing

The stereo image pair is loaded in grayscale, which is a prerequisite for disparity computation.

```
imgL = cv2.imread('left.png', 0)
imgR = cv2.imread('right.png', 0)
```

(a) Left Image

(b) Right Image

Figure 1: Stereo Image Pair 1

2.2 Disparity Map using StereoBM

StereoBM is a traditional block matching algorithm. It's fast and suitable for real-time applications, but may be less accurate in textureless or complex regions.

```
stereo = cv2.StereoBM_create(numDisparities=16, blockSize=15)
disparity = stereo.compute(imgL, imgR)
```

2.3 Disparity Map using StereoSGBM

StereoSGBM provides improved accuracy by considering pixel relationships across multiple directions.

```
stereo = cv2.StereoSGBM_create(
    numDisparities=16,
    blockSize=5,
    P1=8*3*5**2,
    P2=32*3*5**2,
    disp12MaxDiff=1,
    uniquenessRatio=15,
    speckleWindowSize=50,
    speckleRange=2
)
disparity = stereo.compute(imgL, imgR)
```

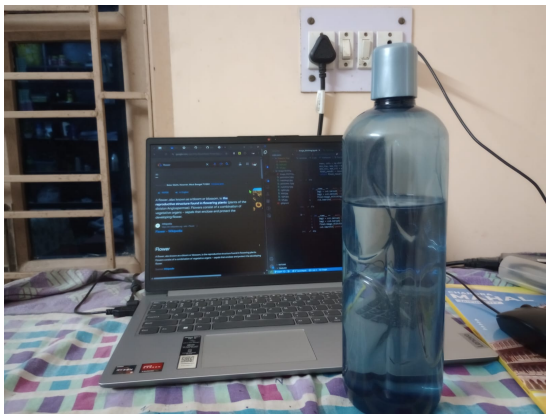
Figure 2: Disparity Map

3 Results and Analysis

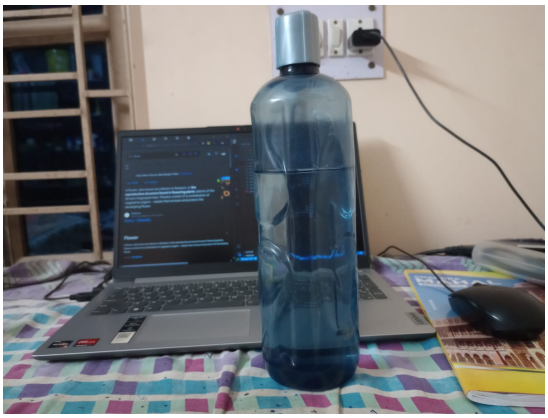
Both disparity maps successfully highlight depth differences in the scene. Key observations:

- **StereoSGBM**: More refined and accurate at the cost of computation time.

I have implemented by taking 2 pictures here is the result:



(a) Left Image



(b) Right Image

Figure 3: Stereo Image Pair 2

Figure 4: Disparity Map

4 Conclusion

This project demonstrates two core algorithms in stereo vision—StereoBM and StereoSGBM—for disparity estimation. The disparity map provides a depth representation, which is vital in autonomous navigation, robotics, and 3D reconstruction.

5 Future Work

- Implement real-time video disparity estimation.
- Experiment with custom calibration and rectification for better alignment.
- Use machine learning-based stereo matching for superior accuracy.