天津工業大學
TIANGONG UNIVERSITY

实 验 报 告

课程名称： Computer Vision

专业班级：Artificial Intelligence

组　　别： 2020

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开课学院:人工智能学院

Experiment 5

Stereo Vision Depth Mapping

一、Purpose:

The purpose of this experiment is to perform stereo vision depth mapping using two grayscale images captured by left and right cameras. Stereo vision involves capturing a scene from slightly different perspectives, mimicking the human binocular vision. The goal is to calculate the depth information of the scene by computing the disparities between corresponding points in the left and right images.

二、Steps:

- Image Loading:

The code starts by loading two grayscale images, "l_active.png" and "r_active.png," representing the left and right camera views, respectively.

- Stereo BM Configuration:

The stereo block matching (SBM) algorithm is employed for depth mapping. Parameters such as focal length (fx), baseline distance between cameras (baseline), number of disparities (disparities), and block size (block) are configured.

- Disparity Calculation:

The SBM algorithm computes the disparity map, which represents the pixel-wise differences between the left and right images.

- Depth Calculation:

Using the computed disparities, the code calculates the depth information for each pixel. The depth is determined based on the camera parameters, focal length, baseline distance, and a depth unit factor.

- Visualization:

The depth data is then visualized using a colormap (JET) to represent different depth levels. The visualization is enhanced by equalizing the histogram of the depth data.

三、Observation:

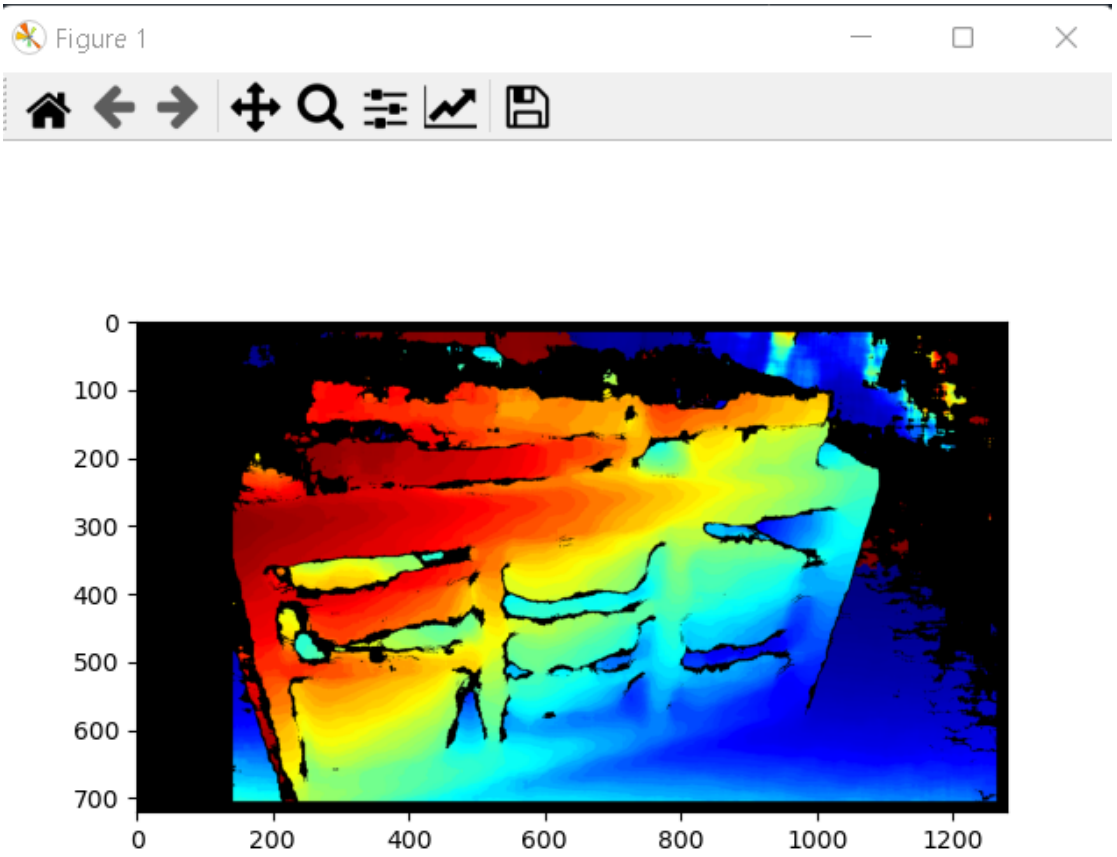
- The disparity map reveals areas of the scene where there are differences between the left and right images.
- Depth information is calculated based on the pixel disparities, providing a sense of the spatial layout of the scene.
- The visualization helps in understanding the depth distribution, with warmer colors (red, orange, yellow) indicating closer objects and cooler colors (blue, green) representing farther ones.

四、Code and Result：

```
import numpy
import cv2
from matplotlib import pyplot as plt

left  = cv2.imread("l_active.png", cv2.IMREAD_GRAYSCALE)
right = cv2.imread("r_active.png", cv2.IMREAD_GRAYSCALE)

fx = 942.8        # lense focal length
baseline = 54.8   # distance in mm between the two cameras
disparities = 128 # num of disparities to consider
block = 31        # block size to match
units = 0.512     # depth units, adjusted for the output to fit in one byte

sbm = cv2.StereoBM_create(numDisparities=disparities,
                          blockSize=block)

# calculate disparities
disparity = sbm.compute(left, right)
valid_pixels = disparity > 0

# calculate depth data
depth = numpy.zeros(shape=left.shape).astype("uint8")
depth[valid_pixels] = (fx * baseline) / (units * disparity[valid_pixels])

# visualize depth data
depth = cv2.equalizeHist(depth)
colorized_depth = numpy.zeros((left.shape[0], left.shape[1], 3), dtype="uint8")
temp = cv2.applyColorMap(depth, cv2.COLORMAP_JET)
colorized_depth[valid_pixels] = temp[valid_pixels]
plt.imshow(colorized_depth)
plt.show()
```

- **Result:**

The code generates a visualization of the depth map using a JET colormap, providing an intuitive representation of the scene's depth.



五、**Conclusion**:

- The code successfully demonstrates stereo vision depth mapping using the SBM algorithm.
- It calculates disparities between left and right images and translates them into depth information, which is then visualized for a better understanding of the scene's three-dimensional structure.
- This technique is valuable in various computer vision applications, such as obstacle detection, scene reconstruction, and depth-based image segmentation.