Pooja Naskar -30

Aim: To study the Depth Estimation

Objective: To Capturing Frames from a depth camera creating a mask from a disparity map Masking a copy operation Depth estimation with normal camera.

Theory:

1. **Depth map:**
   An image or image channel that shows the distances between scene objects' surfaces from a particular viewpoint is called a depth map. Z-buffering, Z-depth, Z-buffering, and depth buffer are all associated with this phrase. Depth maps can be used for a variety of purposes, such as simulating narrow depths of field or the effect of uniformly thick semi-transparent substances inside a picture, such as smoke, fog, or vast volumes of water.

2. **Point cloud map:**
   A discrete group of data points in space is called a point cloud. A 3D item or shape could be represented by the points. X, Y, Z are the sets of Cartesian coordinates associated with each point position.(Source:) Point clouds are typically created by photogrammetry software or 3D scanners that measure a large number of points on the exterior surfaces of nearby objects.

3. **Disparity Map:**
   The apparent motion or pixel difference between two stereo pictures is called a disparity map. Try closing one eye and quickly closing it while opening the other to feel this. Nearby items will appear to leap a considerable distance, whereas farther distant objects will barely move at all. The difference is that motion.

4. **A valid depth mask:**

   A binary image that indicates which pixels in the depth map contain precise depth information is a valid depth mask. The disparity map's disparity values are
   filtered out to generate it. Smaller discrepancies are usually found between closer objects. A appropriate depth mask is necessary to stop erroneous depth information from being processed further.

5. Creating a Mask from a disparity map:

To create an appropriate depth mask, you must provide a threshold range on the disparity values to identify regions with relevant depth information. Pixels with disparities below the threshold are considered real, while pixels with higher disparities may be erroneous. You can be certain that the depth information you mix with other images is accurate if you use this mask.

6. Masking a Copy Operation:

Applying the appropriate depth mask to selected areas of the depth map is the process of masking. You move the chosen regions from the depth map to equivalent locations in the regular camera image when you do a copy operation. With this procedure, a composite image is produced that combines depth information with the look of the typical camera image.

7. Depth estimation with a normal camera:

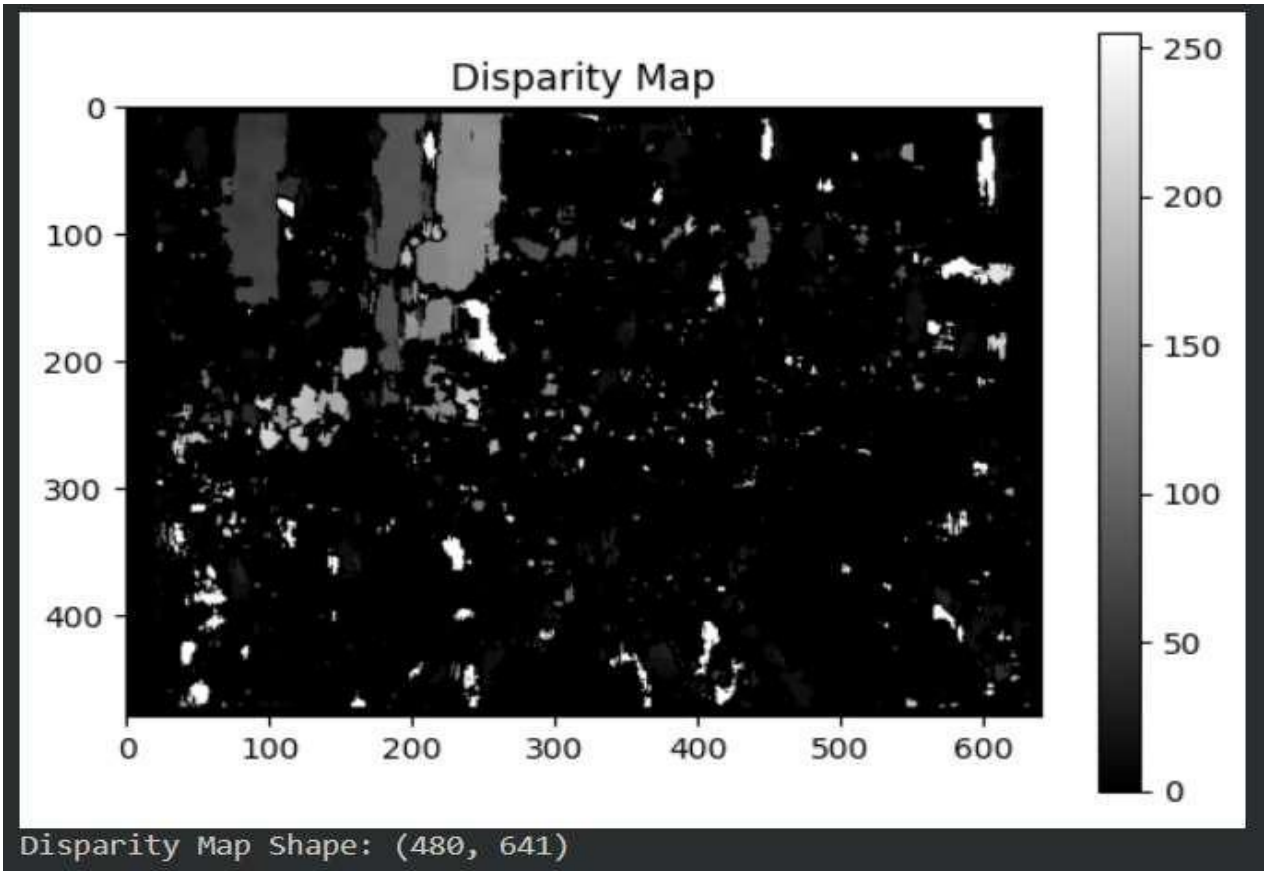
Monocular Depth Estimation is the task of estimating the depth value of each pixel given a single RGB image. Numerous visual clues are used while estimating depth using a standard camera (monocular depth estimate). The size of an object, perspective and texture gradients (dense textures signal proximity) are some examples of these cues.

Code:

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

imgL = cv2.imread('/content/sample_data/Img1.jpg', 0)
imgR = cv2.imread('/content/sample_data/Img2.jpg', 0)

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

normalized_disparity = cv2.normalize(disparity, None, alpha=0, beta=255,
norm_type=cv2.NORM_MINMAX, dtype=cv2.CV_8U)

plt.imshow(normalized_disparity, 'gray')
plt.title('Disparity Map')

plt.colorbar()
plt.show()
print("Disparity Map Shape:", disparity.shape)
```

Input Images:

Output:



Conclusion:

The process of determining each pixel's distance from the camera is known as depth estimation. Images of a scene are captured in either monocular, or single, or stereo, perspectives, from which depth is derived. Depth estimate has several uses, such as shadow mapping in 3D computer graphics, better rendering of 3D sceneries, and smoothing out areas of a picture that are blurry. We were able to effectively apply the idea of disparity map-based depth estimation in this experiment.