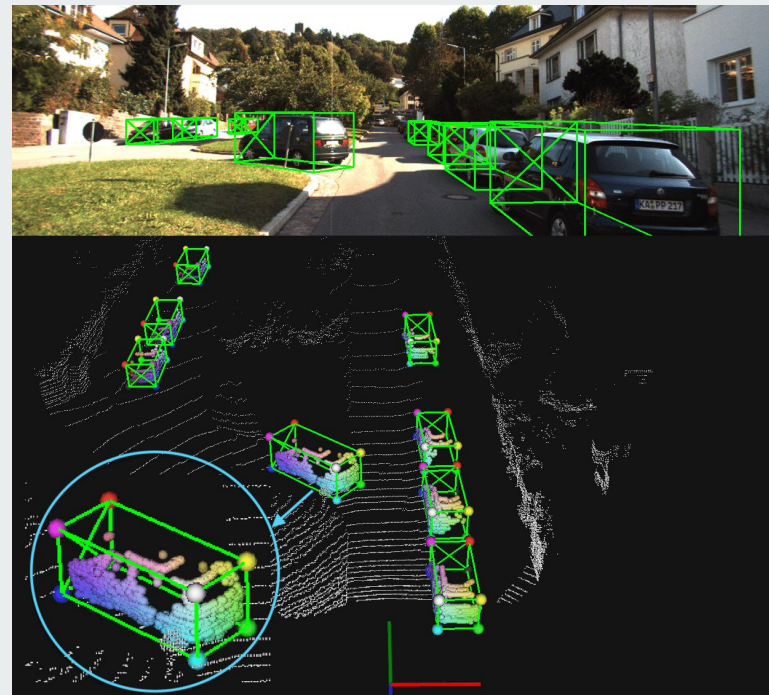


3D Computer Vision

An Introduction to Applications and some basic terminologies

Bangalore AI & ML group meet-up
Oct 19th, 2019



Part-A² Net: Shi et al. 2019



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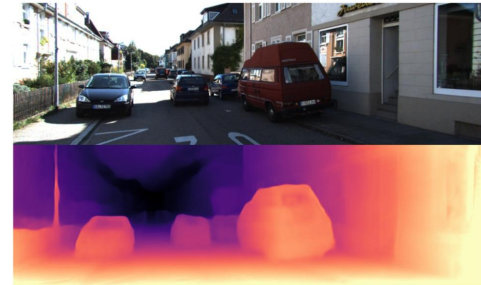
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Contents :-

1. Introduction
2. Problems
3. Reconstruction
4. Object Detection
5. Segmentation
6. Applications
7. Resources

Introduction

- Computer Vision :- “Programming computers to analyse and understand the images and scenes”. (perception and interpretation)
- 3D Computer Vision :- Machine can understand the depth in images with color features. In other words system would be able to extract and process the 3d structure of objects and scene.(measurements)

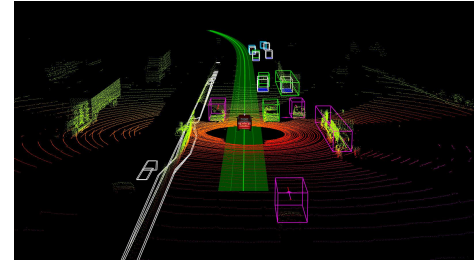


Monodepth, Godard et al., 2019

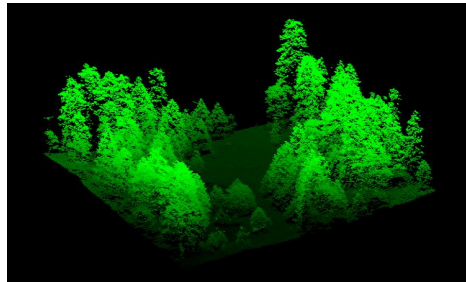
Sensors

1. Stereo Camera (Kinect, Intel RealSense etc.)
2. IR, LIDAR(Light Detection and Ranging)

With help of these sensors especially with stereo camera, the system can take a pair of pictures and calculate the disparity map from those pictures, these disparity map can be used to create a point cloud model.



<https://www.extremetech.com/wp-content/uploads/2015/09/Lidar.jpg>



<https://ucanr.edu/blogs/Green/blogfiles/11605.png>



Sensors

1. [Lidar](#)
2. <https://www.intelrealsense.com/stereo-depth-vision-basics/>



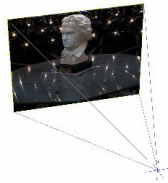
Problems

- Classification
- Object Detection
- Segmentation
- Data Generation

There are traditional ways to solve each of the above problems. But with help of data driven AI like deep learning, Machine learning now the problems can be handled easily. We'll cover the deep learning applications to 3D vision.

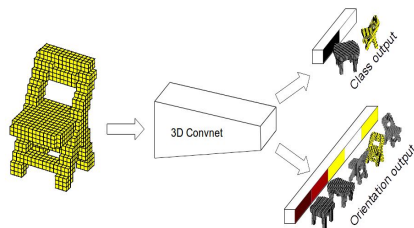
3D Reconstruction

It is the process of capturing the shape and appearance of real objects.



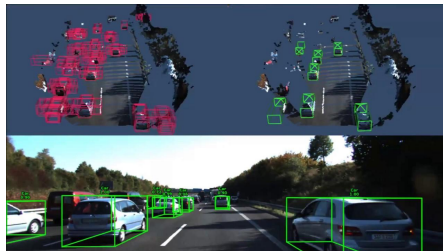
Classification

- The most common form of true 3D image is the color– depth pair known as a red-green-blue-depth (RGB-D) image. These images offer a partial 3D view into a scene, allowing a network to learn full spatial relations of objects
- task designed to identify a specific object or scene.



Detection

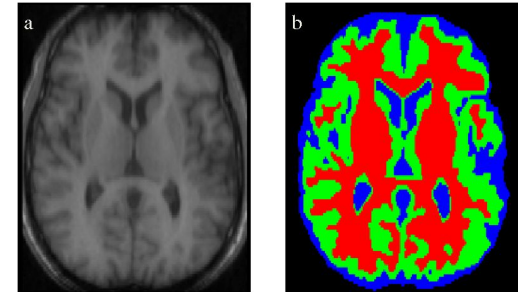
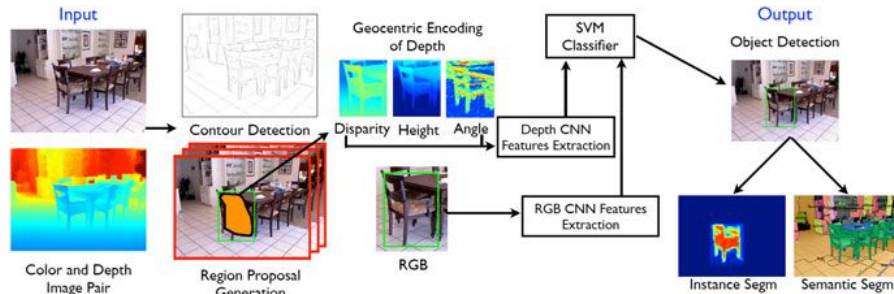
- It means to find the object in a scene/image and occurrence can be output as either a bounding box or cuboid.
- In the 3D setting, classification takes a similar meaning with the additional challenge of recognizing the 3D shapes of objects, scenes, and the 3D relation of objects within scenes.



AVOD Jason Ku et al. 2017

Segmentation

- performing classification+ detection together gives a semantic segmentation of a scene, which involves detecting all objects and classifying them.
- Segmentation is the classification of individual pixels. So, it can be thought of as fine-grained classification. A notable difference is that segmentation does not deal with the notion of individual objects, but rather which pixels in a picture belong to which category.





Applications

- Autonomous Cars
- Robot Navigation and grasping.
- Medical Imaging.
- Manufacturing Inspection.
- 3D Mapping
- Virtual Catwalk
- [Esri](#)
- Synthetic Dataset Creation

There are numerous applications of 3d computer vision and it's spreading because of growing amount of data and computation power.



Datasets

[Kitti](#)

<https://github.com/facebookresearch/House3D>

<http://suncg.cs.princeton.edu/>

<http://cvgl.stanford.edu/projects/objectnet3d/>

https://cs.nyu.edu/~silberman/datasets/nyu_depth_v2.html



Libraries & Tools

1. OpenCV
2. Kimera
3. The Point Cloud Library
4. Meshlab
5. OpenGL

...



Resources & Reference

- <https://github.com/flamato/3D-computer-vision-resources/blob/master/README.md>
- https://en.wikipedia.org/wiki/Computer_vision
- <http://pointclouds.org/>
- http://bbs.cvmart.net/articles/355/zi-yuan-wan-zi-chang-wen-zi-yuan-zhi-3d-machine-learning?order_by=vote_count&
- <https://paperswithcode.com/task/3d-object-detection>
- <https://venturebeat.com/2017/01/29/8-cool-new-ways-computer-vision-is-changing-everything/>
- <https://opencv.org/>
- <https://medium.com/vitalify-asia/create-3d-model-from-a-single-2d-image-in-pytorch-917aca00bb07>



Thank You!