Color of Pointcloud Matters!

3D Object Detection by Colorful Pointcloud Alignment Between RGB-D Pointcloud and Lidar Pointcloud

Saeed Firouzi
Sharif University of Technology
saeedmr881@gmail.com

Abstract

One of the most critical task in autonomous vehicle is to detect different kind of object in the environment. Detecting these objects are important due to different reaction we have with them. Finding these objects without the colors or fusing lidar pointcloud with image , without aligning color of pixels of image to the lidar pointcloud, is hard for the model to understand it. But in this work, we first align image and pointcloud lidar and then give a color to the every poitcloud, and then with these colorful pointcloud we can detect different objects with a voxel-based CNN-Transformer model that has a better performance to the other models.
The training code and pre-training model are available at
https://github.com/saeed5959/3d-object-detection
to help open source community.

1 Introduction

One of the most critical task in autonomous vehicle is to detect different kind of object in the environment. We can divide these objects into 2 categories: 1-active objects 2-inactive objects. Objects like rock, box, wall, tree, … are all inactive objects that can not move and the only important thing about them is to not collide with them. With lidar pointcloud you can detect these and avoid them. But car, cyclist, human, traffic line, … are active objects that some of them can move and some of them have interaction with environment. Detecting these objects are important due to different reaction we have with them.

If we detect a car in the path that is moving we can be in behind of that can or we can switch the line. If we detect a human in the middle of the road we must reduce our speed and change the line to avoid the collision. Or if we detect a traffic line we should find the color of it; red for stop and green for movement.

So beside of avoiding the collision, there are some other task when a can encounter with active objects. Here detecting these active objects makes this task more important.

Old methods, use just the lidar sensor to get a accurate 3d pointcloud from the environment, but these pointcloud are without color that makes it very hard for model to detect objects. Fortunately, new method “fusion” use a camera beside of lidar sensor to

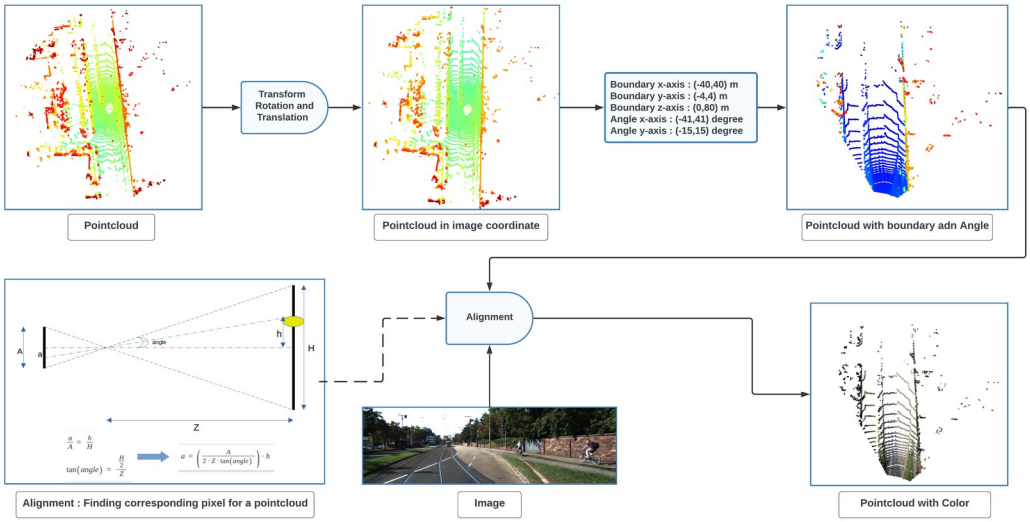

Figure 1 : **Alignment between pointcloud and image**. Giving the color of pixel in image to the corresponding pointcloud

take a picture from environment. They align this camera with lidar sensor to use both data in their model but separately. This method gives both lidar pointcloud and image to the model and model tries to make a connection between pixels of image and pointcloud. This indirect connection affect the performance of the model. But in our method we take away this barrier and directly make a connection between them.

The critical thing in here is that this alignment between camera and lidar sensor must be accurate.

Our main contributions is:

- Making a colorful pointcloud from alignment between image and lidat sensor
- Propose a new method in 2d backbone

2 Alignment

Lidar sensor take data from the environment in 360 degree. But camera can only take image from a part of environment and in a specific angle. But first of all we should transform lidar pointcloud from lidar coordinate to the camera coordinate. And then we should find the boundary and then find the angle of image in y-axis and x-axis. And then for any pointcloud, calculate relative position in y-x plane based on z-axis data (depth) and transform it to the image plane and assign the color of corresponding pixel to that pointcloud.

3 Model Architecture

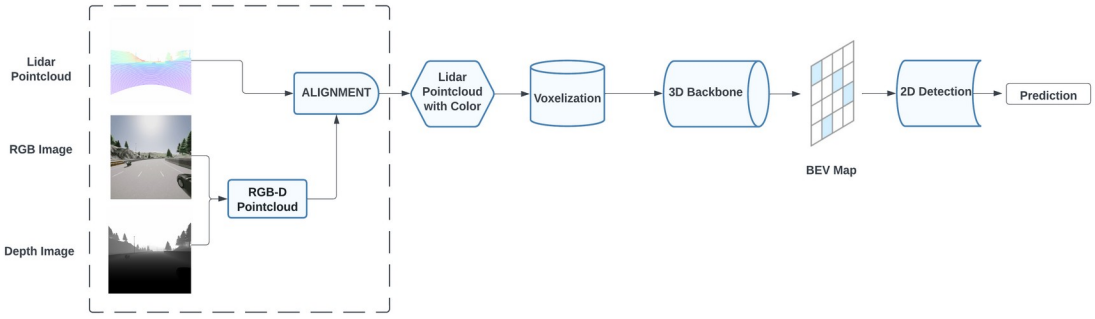

Figure 1. **An illustration of model architecture**