

Image Processing Speed Improvement Using Sensor Fusion for Autonomous Driving System

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Abstract : Template matching is a method for image recognition. Existing template matching algorithms compare all two-dimensional pixels in an image to measure their similarity to the comparison object (template). This can be seen as an inefficient way of comparing insignificant parts of an image. This inefficient method can be used more efficiently by setting the region where the object exists as an ROI (region of interest) through LiDAR and comparing only that region.

Key words : Sensor Fusion, Image processing, Autonomous Driving, ROI(region of interest), Template Matching

1. INTRODUCTION

Image classification methods include deep learning, machine learning, and template matching. For image classification, finding an object in the view must be preceded. In the traditional method of finding objects, template matching scans the entire image against a template image (feature image). This is the simplest way to find an object, but it is inefficient in terms of computer processing speed and processing time because it scans unnecessary areas. The most important thing in autonomous driving is the fast compute time for quick response to the environment, and to improve this, this paper mainly aims to improve the algorithm using LiDAR-Vision sensor fusion.

2. SENSOR PROCESSING

Dataflow is working like Fig. 1. This section describes how each sensor processes data.

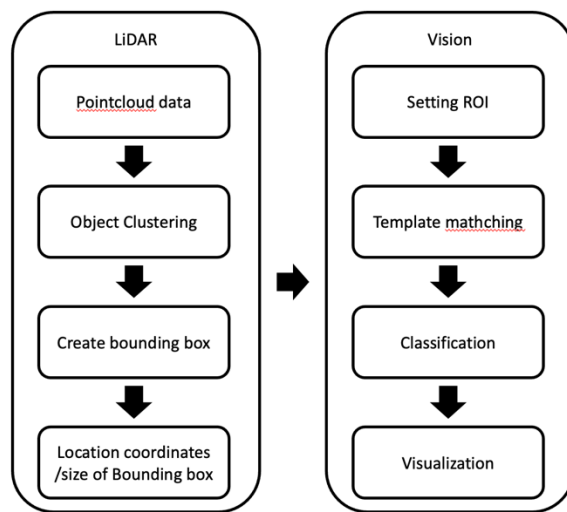


Fig. 1 Flow Chart of Algorithm

2.1 Clustering

A clustering algorithm was used together for a group local point cloud cluster. Open3D implements DBSCAN, a density-based clustering algorithm of reference paper [3].

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2.2 Calibration

The rider and camera are fixed to each other. Since the lidar and camera directions are the same, the camera direction sets the x-axis direction, which is the front of the lidar, and the bounding box created by clustering is projected perpendicular to the y-z plane for calibration.

2.2.2 Template Matching Method

Template matching is a digital image processing technique for finding small parts of an image that match a template image. OpenCV provides 6 methods for template matching. I used the TM_CCOEFF_NORMED method, which is robust to light changes [2].

The TM_CCOEFF_NORMED method performs template matching using the expression shown in (1) below which is robust to light changes

$$R(x,y)=\frac{\sum x'y'(T'(x',y')\cdot I'(x+x',y+y'))}{\sqrt{\sum x'y'T'(x',y')^2\cdot\sum x'y'I'(x+x',y+y')}} \quad (1)$$

3. Experiment Environment

The vision sensor was Logitech C922n, and the lidar used Velodyne VLP 16, and the specifications of each sensor are as table 1.

	VLP 16	Logitech C922n
Type	LiDAR	CAMERA
Range	360°	78°
Frequency	100hz	60fps
Resolution	0.2° / 1°	1920 x 1080
Protocol	Ethernet	USB

table 1 Specifications of the equipment used in the experiment

4. Result

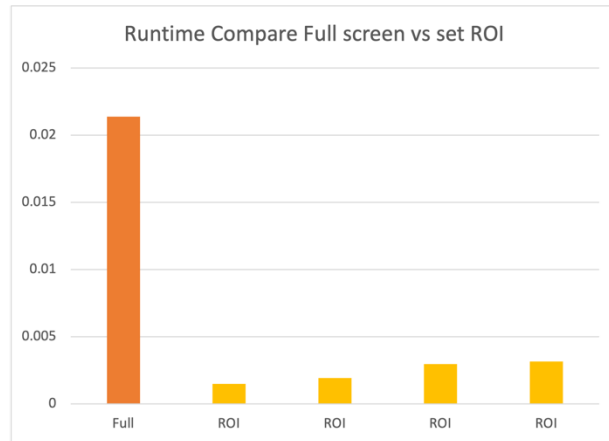


Fig. 2 Runtime(sec) compare Full screen & ROI

The above experiment (Fig. 2) showed an average speed improvement of 7 to 14 times.

The result will be different depending on the ratio of the area occupied by the template in the ROI, but it is faster than when no ROI is set.

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