VEHICLE CLASS RECOGNITION OF STREET-PARKING VEHICLES FROM SIDE-VIEW RANGE IMAGES

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ABSTRACT

This paper describes a novel method for recognizing the classes of street-parking vehicles. We have already developed the following two systems: one is vehicle recognition system based on local-feature configuration, and the other is detecting street-paring vehicles from side-view range images. In this paper, we combine these two systems to develop a new system with which we can not only count the number of street-parking vehicles but also recognize their class of vehicle type such as sedan, wagon, mini-van or so. We have confirmed that our classification algorithm is still robust on range images, performing outdoor experiments. Our system can recognize four vehicle classes of sedan, wagon, mini-van and hatchback from outdoor range images with accuracy of about 80%.

INTRODUCTION

In Japan, there are heavy traffic congestions. There are several reasons that causes them, but one of them is that parking vehicles on street decrease the capacity of the road network. It is known that the traffic congestion might be drastically decreased if only several percent of parking vehicles disappear. Therefore, it is very important for Japanese road administrator to know the availability of road in time and space; how many vehicles are parked, or how long vehicles are parked. If we can obtain these statistics, we will have possibility of novel management system. But now we can obtain these statistics only once per several years, because there is no automated counting system: just as in old days, when people needed to count cars on street with hand to obtain traffic demand. We have already developed a street-paring vehicle detection system based on laser range finder [1].

On the other hand, recent vision technique has been developed to apply a lot of intelligent sensing systems. In other words, we can extract not only the number of vehicles but also type, speed of them for example. In fact, we have already a vehicle class recognition system[2][3].

Thus we have realised that we will obtain a novel street-paring recognizing system if we combine the previous two systems. The summary of the novel system is as follows:

1. A measurement vehicle with laser sensor runs on street to obtain range images.
2. Using depth, segment each area of street parking vehicles
3. On the other hand, we have prepared training depth images of typical vehicles for several vehicle classes and made model of each vehicles.
4. Apply our recognition algorithm on each segmented parking vehicle to determine the class of the vehicle.

In the followings, we explain these further.

STREET-PARKING VEHICLE SEGMENTATION

Figure 1 (a) shows our scanning system. The range sensor is type of line-scanning, hence, we can obtain range images as shown in figure 1 (b). Our system can segment street-parking vehicle area from this kind of image (figure 1(c)) [1].

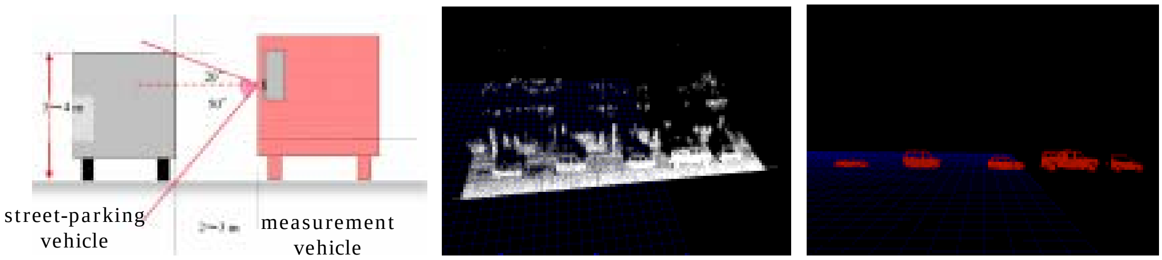

Figure 1: (a) system configuration (b) a range image, (c) segmented vehicles

VEHICLE-CLASS RECOGNITION

We have already proposed an algorithm to recognize vehicles based on local features. The algorithm is described as follows (see figure 2). At first, we make models of vehicles of typical classes, such as sedan, wagon and so on, in advance. Each model consists of configuration of local features. Secondary, for each input images, extract local features from the input image, to obtain configuration of local features. Matching the configuration with that of the models made in advance to find which model exists at which location[2][3].

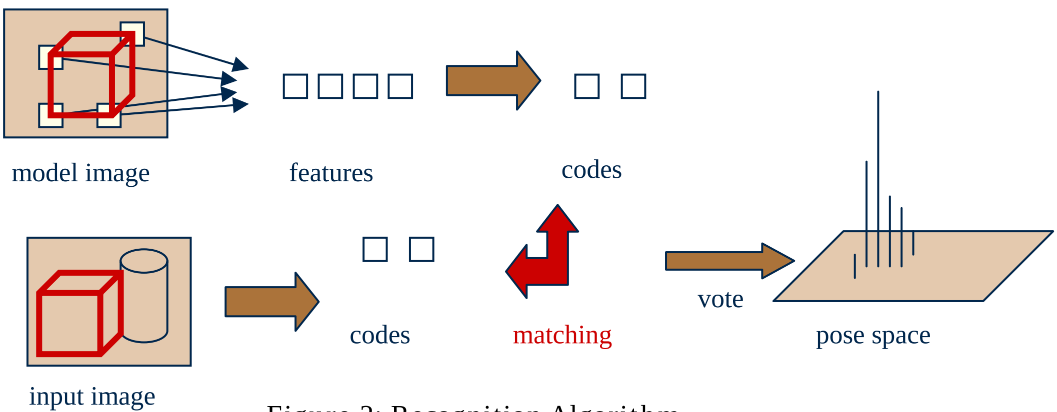

Figure 2: Recognition Algorithm

NOVEL APROACH

Combining the previous systems, we can expect that our system will be able to recongnise vehicle classes of street-parking vehicles. We applied our recongnition algorithm only on video images so far, but we can apply it on range images whose intensity is distance from the measured vehicle instead of the intensity of objects. We also need to improve our algorithm. We have prepared the models of typical vehicles in several diffenent sizes so that our measurement vehicle can run in different speed.

Figure 3: Training images of different sizes

Figure 3 shows examples of different training range images. The height of the vehicle is the same in both images, but the lengths are different according to the speed of our measurement vehicle.

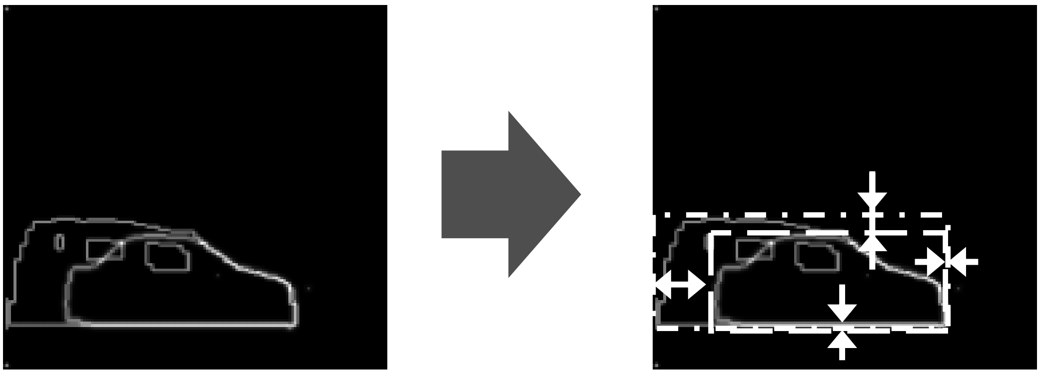

Figure 4: Bounding box check

In matching process, we compare the bounding box of the extracted vehicle from each input image with that of a candidate vehicle. If the difference of those bounding box is small enough, then we accept the candidate vehicle.

The following figure 5 shows examples of traing images.

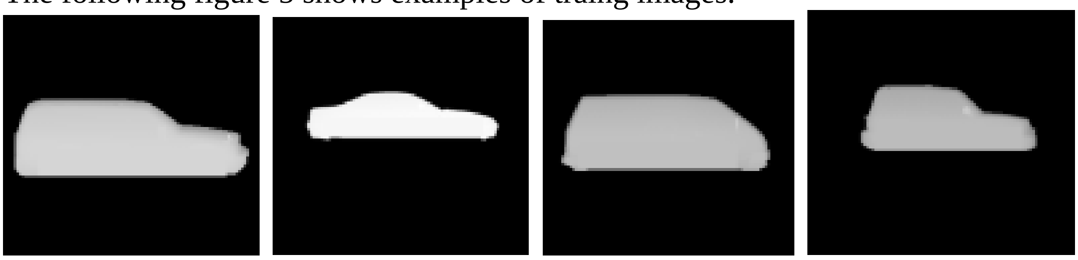

Figure6: Exapmles of CG-based depth training images

OUTDOOR EXPERIMENT AND RESULTS

We have performed outdoor experiment. Figure 7 shows some examples of extracted vehicles from input depth images.

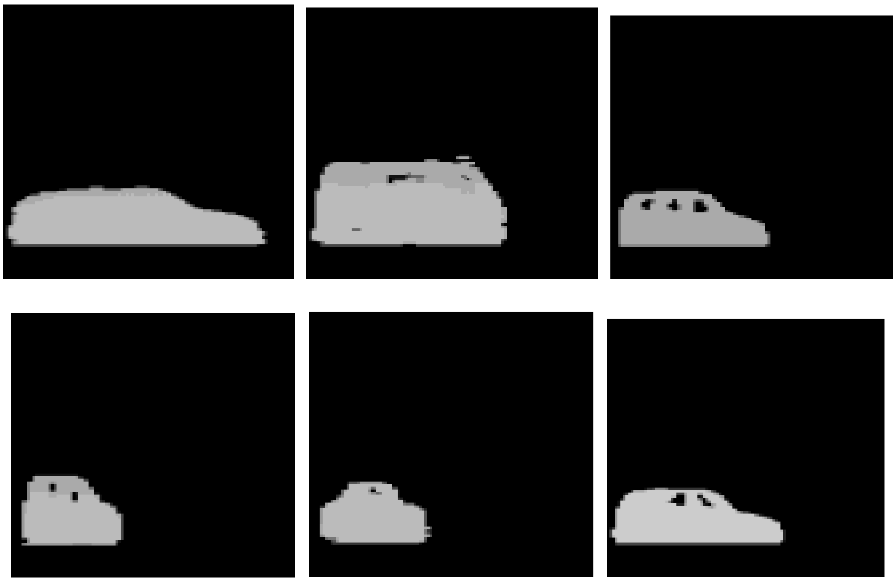

Figure 7. Examples of extracted vehicles

We have obtained the following results.

Classified as	Real class			
	Sedan	Mini Van	Hatchback	Wagon
Sedan	10/10	0/6	5/9	1/9
Mini Van	0/10	5/6	0/9	0/9
Hatchback	0/10	0/6	4/9	0/9
Wagon	0/10	1/6	0/9	8/9

Total recognition ratio=79%=27/34

Table 1. Classification result

It is true that the system often confuse vehicles of sedan and hatchback, but actually both vehicles are similar except for their size. Wagon type vehicles are similar to sedan-type vehicle if we ignore rear trunk. Considering these facts, our results is not bad.

CONCLUSION

We have combined two different systems to obtain a novel system which can not only detect street-parking vehicles but also recognize vehicle classes. This system will help road administrator to know implications for traffic congestion on street.

REFERENCES

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