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License Plate Recognition for Parking Management System using UAV Vision

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Abstract. The parking management system (PMS) using the drone camera is one of the challenging task and trending technologies of computer vision that can help to solve the parking problem. In this paper, we proposed a new PMS and a method to improve the performance of license plate recognition (LPR) in existing PMS based on drone camera. The proposed method is evaluated using 41 person-identifiable license plate images selected from the Mini-drone video dataset. An open source optical character recognition (OCR) engine called Tesseract is used for LPR, where the results are improved by the proposed look up table which is made from existing PMS.

Keywords: Drone, Optical Character Recognition, Tesseract, License Plate Recognition, Parking Management System

1 Introduction

In modern era, vehicles parking problem is one of serious issue of social life. Especially, it is becoming an important issue to secure a stable parking space for individuals within a limited parking space. A PMS is essential to solve this problem. However, in order to construct an efficient and practical system, many equipment and cost problems arise. A PMS using drones is a relatively simple way to simplify these problems with minimal cost. The core function of the PMS is in LPR. Many researcher have been developed different methods for PMS. The first study is a parking monitoring system using a drones which contain parking detection and car recognition system. Developers have developed an LPR function by using OpenCV (Open Source Computer Vision) and Tesseract[1]. A novel illegal parking interception system is developed using OpenALPR (Open Source Automatic License Plate Recognition) [2]. A common of these two studies is that they create an LPR system and apply it to a PMS. Since LPR is applied to almost all traffic control systems besides PMS, other studies are also being actively studied. For example, there are many research articles such as

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LPR using Convolutional Neural Network and LPR in mobile system environment [3], [4]. This study proposed a new PMS which improves LPR performance of drones by using existing parking system.

2 Proposed System

In this section, the proposed method is explained in detail. The framework of the proposed PMS using drones is shown in Fig. 1. The system first recognize the license plate of car at entrance and exit using the existing LPR camera installed in the parking lot. The recognized result is checked in registered cars in the database. This checking of registration information serves as a look up table to improve the LPR performance of the drone. Look up table is used to refer to the difference between characters when the OCR result is partially not correct and to change it to the correct character. Using the look up table gives a higher performance than the normal OCR. The drone stores the vehicle information in a parking map, stores it in a database, and provides the location service to consumers through this information. Due to a limited testing environment, we conducted a LPR performance test on a drones using a Mini-drone video dataset, which contains several situations that can occur in a parking lot.

Fig. 1. Parking lot management system

2.1 Tesseract OCR Engine

Tesseract is an open source optical character recognition engine developed by Google [5]. Initially this project was owned by HP labs during the time period of 1984 and 1994. Since 2006 Google started sponsoring this project and made a major breakthrough in its development process which made it the most accurate text recognition OCR engine among many others. It is originally developed in C/C++ programming language but it can be complied for other development platforms as well such as Java, C#, Android etc. Text recognition process in tesseract is composed of

traditional step-by-step image processing pipeline. The main steps of the algorithm used for text detection and recognition are presented.

2.2 Look up table Approach

The look up table approach is a method to improve OCR performance [6]. The difference between the recognized license plat from the OCR and the registered words in the look up table is calculated using the edit distance and select a registered number having minimum distance value. Edit distance calculates how many times to change when converting from one character to another, and expresses it as a difference.

2.3 Mini-drone Video Dataset

The Mini-drone Video Dataset is good test data for the parking space system and the video data on what can happen in the parking space [7]. 38 images in full HD resolution are composed of various contents about 20 seconds. There are various examples such as accident in parking lot or ignoring parking line. The information on the license plate included here number of license plate and location of the license plates, but does not provide information on the license plate character. Therefore, a separate tagging operation is required to test the LPR. For the efficiency of the test, we used the image editor like Adobe Photoshop to edit the image in the dataset.

Fig. 2. License plate extraction process in dataset

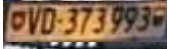
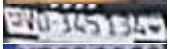
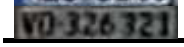
3 Experimental Results

The proposed method is assessed using Mini-drone videos dataset. We selected a total of 41 images at different points of 20 car license plates. The data selected for the test is not a dataset designed to test LPR, which has much less resolution than common LPR datasets. Although people only used identifiable images, 29 of the 41 images were matched to achieve an accuracy of 70.7%. The experimental results shows that the proposed OCR framework improve the original Tesseract. Tables 1 and 2 shows the comparison between the results obtained using the original Tesseract and the final results by utilizing the edit distance and look up table.

Table 1. Explain of the code for table 2

Code	Result	Description
A	Correct	When 4 or more extracted text and ground truth are equal
B	Correct	When the extracted text and ground truth are equal to 3 or less
C	Wrong	When Ground Truth and Look up table text are different
F	Wrong	When Extracted text is empty

Table 2. The results of 5 sample images.

Input Image	Ground Truth	Extracted text	Look up table text	Code(Number of the matched)	Result
	NIN8596	NNN488	NIN8596	B(2)	Correct
	VD373993	10700373233	VD373993	B(3)	Correct
	VD345134	None	None	F	Wrong
	NESJJ88	185545172	VD254591	C(0)	Wrong
	VD326321	90326321	VD326321	A(6)	Correct

4 Conclusion and Future Work

In this paper, we proposed a PMS using drone. The LPR result is processed using the proposed lookup table based method for better performance. We have evaluated the system using benchmark dataset of drone videos on which we got 70% accuracy. But it is examined that the dataset is low resolution so the quality of license plate is very low. Therefore, it is expected that a higher resolution drone data will have a much higher accuracy. We aim to implement the PMS in the future where the actual location information and service application will be provided to consumer.

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