

Development of Automatic Number Plate Recognition Based for Car Parking System

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ABSTRACT – Car parking is essential since the car is a major transportation. However, most car parking systems utilize tickets to allow vehicles to ingress and egress. This conventional approach arises several drawbacks to a user such as a ticket may lose or damaged, time-consuming and deficiency of the payment machine causing a long queue for the ticket payment. Therefore, this paper proposes an Automatic Number Plate Recognition (ANPR) based car parking system to overcome those problems. This project utilized a Raspberry Pi as a microcontroller and consists of hardware and software development. The hardware development involves an IR sensor to detect vehicles and a Pi camera to capture number plate images. The software development involves the recognition of the number plate by OpenCV, the authentication process with the existing data in the database and updating the system data which used a parking web-based system. The testing result shows that the ANPR technique can recognize number plates less than 1.10 s, record the time vehicle is in and out, and make cashless payments by deducting from the user's account. Therefore, this project able to be implemented in the car parking system to meet the community's needs.

1. INTRODUCTION

Parking has become an essential part of transports planning today. Most car park management system uses printed paper tickets for payment purposes. This conventional approach arises several drawbacks to a user such as a ticket may lose or damaged, time-consuming and deficiency of the payment machine causing a long queue for the ticket payment. Thus, an automated, user-friendly, and time-saving car parking system is needed for a better approach.

Automatic Number Plate Recognition (ANPR) is an image processing that automatically locates and extracts plate number information. ANPR is known by many other names, including Automatic Vehicle Identification (AVI), License Plate Recognition (LPR), and Car Plate Recognition (CPR). ANPR system is a real-time surveillance system that uses Optical Character Recognition (OCR) on images captured to read the number plate of a vehicle [1][2].

Since the ANPR plays an important role in real-life applications especially for parking management and traffic monitoring, thus this paper proposes an ANPR based car parking system.

2. METHODOLOGY

Figure 1 shows the flow of the system in which the car plate number will be captured by Raspberry Pi's camera, once it is detected by an infrared (IR) sensor. This number will be processed and matched with the number in the database. The car is allowed to enter once it's matched and all the data will be stored in the parking system.

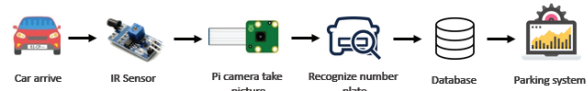


Figure 1 Project flow of the system

This system is divided into two parts which are hardware and software design. The hardware design involves the process at entry and exit gate barrier to detect the vehicle, capture the number plate, display information on the LCD and open the gate barrier. The processes are controlled by Raspberry Pi model 4 with 2GB RAM. Meanwhile, the software design involves the interaction of the user and administration with the parking web-based system. To create this GUI, it requires the use of HTML, PHP, and MySQL database.

3. RESULTS AND DISCUSSION

Figure 2 shows the prototype of the car parking system. This prototype involves only one gate barrier for a vehicle to enter and exit the parking lot. The IR sensor is placed in front of the gate barrier to detect the vehicle and triggered the Pi camera to capture an image and recognize the number plate.



Figure 2 Prototype of the car parking system

The recognition process is started by changing the captured image from RGB color to the black and white background to reduce the usage of colors in the image.

Next, Region of Image (ROI) is extracted to be cropped in rectangle shape as shown in Figure 3(a). The extracted image is again performed pre-image processing and threshold image process as the results in Figure 3(b). The testing result shows that the time taken to process and recognize the number plate is less than 1.10 s as depicted in Table 1.



Figure 3 Image recognition process

Table 1 Time taken for number plate recognition

| Number Plate | Time taken for 4 trials [s] | | | | Average time [s] |
|--------------|-----------------------------|------|------|------|------------------|
| | 1 | 2 | 3 | 4 | |
| PNG 2354 | 1.07 | 1.14 | 1.04 | 1.13 | 1.10 |
| KEH 1769 | 1.06 | 1.01 | 1.02 | 1.08 | 1.04 |
| KBQ 7487 | 1.05 | 1.03 | 1.09 | 1.07 | 1.06 |
| PPO 2504 | 1.03 | 1.01 | 1.02 | 1.05 | 1.03 |
| ALK 7980 | 1.08 | 1.06 | 1.10 | 1.05 | 1.07 |

The result shows that 79% (27 samples) and 21% (7 samples) of the test sample managed to recognize the number plate precisely and were unable to recognize the number plate, respectively. Figure 4 depicted the samples of misleading characters of the number plate.



Figure 4 Misleading characters of number plate

The misleading characters of the number plate is generally due to the non-standard number plate used by the owner since the proposed system utilized a standard character for recognition. The non-standard number plate also should be recognized for a smooth management of the car parking system. Hence, in future, machine learning algorithms can be employed to recognize images and the machine learning model should therefore be trained with various datasets of number plate including the non-standard number plate images. Besides, for the character recognition, convolutional neural network (CNN) architecture could be implemented since it is one of the promising algorithm for object recognition [4][5].

The web-based system for this work is used PHP and HTML language. This system communicates with the hardware by using MySQL database to obtain the data generated by the hardware system. Figure 5 and Figure 6 show a sample of car parking system website and LCD, respectively. The LCD displayed the number plate and user account balance in Ringgit Malaysia.

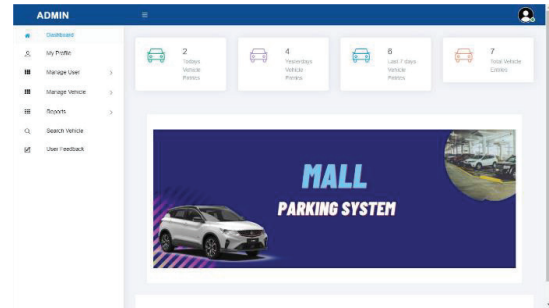


Figure 5 Interface of car parking system website



Figure 6 User number plate and account balance

4. CONCLUSIONS

In conclusion, the performance of this work is evaluated based on the execution time for processing of images and recognition of the number plate characters as well as speed of execution when the gate barrier is opened. The testing result shows the ANPR technique can recognize number plates less than 1.10 s with 79% of success attempted. This is because the response time for execution depends on the speed of a Raspberry Pi. Using the Raspberry Pi model 4 with 2GB RAM increases time performance rather than the previous version of Raspberry Pi. On the other hand, the user number plate and account balance able to be counted and displayed.

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