

The Design of Parking Space Intelligent Management System based on Technology of Visual Identification

BinShu Chen^a, QingXiang Wu^{*,b}, RongTaiCai^c, LiJuanChen^d, HaiHuiXie^e

Key Laboratory of OptoElectronic Science and Technology for Medicine of Ministry of Education, College of Photonic and Electronic Engineering, Fujian Normal University, Fuzhou, China

^ahaar_like@outlook.com, ^bqxwu@fjnu.edu.cn,

^cgjrtcai@163.com, ^d13400560285@139.com, ^e568082212xhh@sina.cn

Abstract

This paper presents a design of parking space intelligent management system based on visual identification which combines visual image processing technology and intelligent management systems. In the system, visual processing technology is used to extract the vehicle information such as parking spaces, vehicle license plate number, vehicle type, parking position, etc. A set of visual processing related functions are realized such as the parking space indication, vehicle detection, vehicle positioning, timing charging, etc. It is more convenient for users to find a car in a large car park. Cameras are used to monitor parking situation in real-time to achieve the function of electronic patrol. The system provides a convenient and efficient management of a large car park and save labor costs. Based on the architecture of this system, the more visual processing technology can be integrated into the system, such as face recognition, vehicle color and logo recognition and so on. They can improve the reliability and security of parking space management system.

Keywords: visual identification; parking space; intelligent management system

1. Introduction

With the rapid development of China's economy, more and more vehicles are used as the main conveyance of citizens, which not only led to traffic congestion, but also parking difficult problems. Traditional car park management system requires the staff at the entrance, and easily results in lining up for parking. Its low efficiency and usually causes loss of parking fees and security problems. The traditional car park management system has been unable to meet the parking demand nowadays, so parking lot intelligent management system arises at the historic moment and attracts a lot of researchers [1].

Car park intelligent management system can achieve efficient, rapid, intelligent management of the car park. Most of the car park intelligent management system in the current commercial products is aimed at the entrance of a parking lot to achieve parking fee management and vehicle guidance. Although a number of techniques are used to detect parking vehicle such as ultrasonic probe, vehicle detector, infrared detector, RFID electronic tag and reader[2-4], card reader and barcode machine, some of these devices require high maintenance costs, some are not suitable to the temporary vehicle. And the system requires the complicated operations and is lack of humanization. At present, the research of the parking space intelligent management system is far away from maturity, especially very few parking space intelligent management systems are based on visual identification. Therefore this paper presents a study on the design of the parking space intelligent management system based on visual identification technology, mainly for integration of advanced visual processing technologies to intelligent management of parking space.

2. Brief introduction of the overall design

In this system cameras are used to collect vehicle information, and they are placed on entrance, overhead of car park, and each parking space. Overhead cameras are used to monitor vehicle movement track[5] and available vehicle parking space to guide vehicle parking. The cameras corresponding to specific parking space can collect real-time images of the parking spaces. If a parking space has a parking car, the license plate number, vehicle type will be recognized using license plate number recognition[6] and vehicle type recognition algorithms[7]. Based on the recognition results, parking space numbered, parking time and other information are extracted and stored in the Oracle database. At the same time the parking information is displayed on a screen to show which vehicle with a license plate number and vehicle type is parked in which parking space. Finding a car in the car park, a client can input their license plate number on a touch screen to query for the parked vehicles, to find their vehicles and guide the road to the vehicle easily. Through the overhead camera one can view real-time situation of each parking space, to act as an electronic patrol function. It is not only convenient, fast and efficient, but also improves the safety of the vehicle management.

3. Architecture of the System

Hardware resolution

The hardware of system is mainly composed of a parking space data acquisition module, data transmission module and processing terminal equipment, including CCD camera, coaxial cable, 1.2g/2.4g wireless transmitting and receiving module, video capture card, tower server and corresponding

power. The layout of the entire system is shown in Fig. 1.

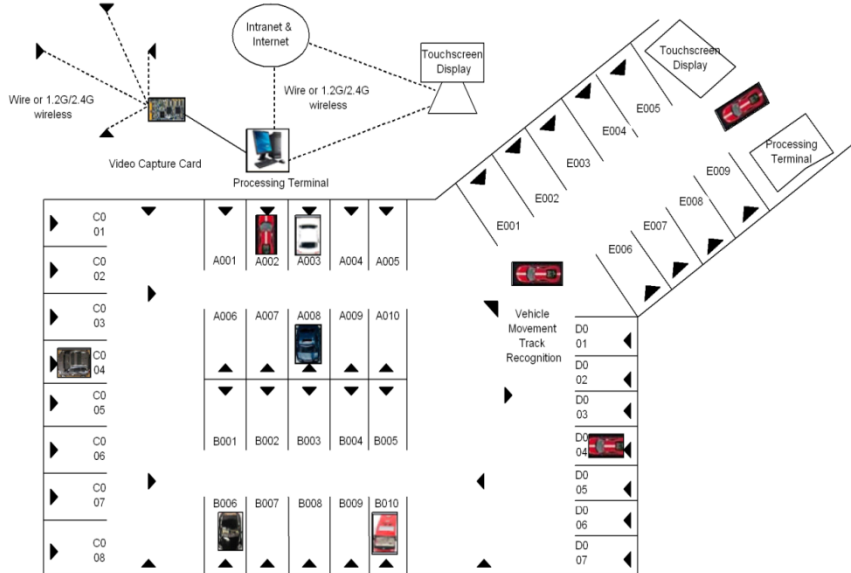


Fig.1. The layout of the entire system

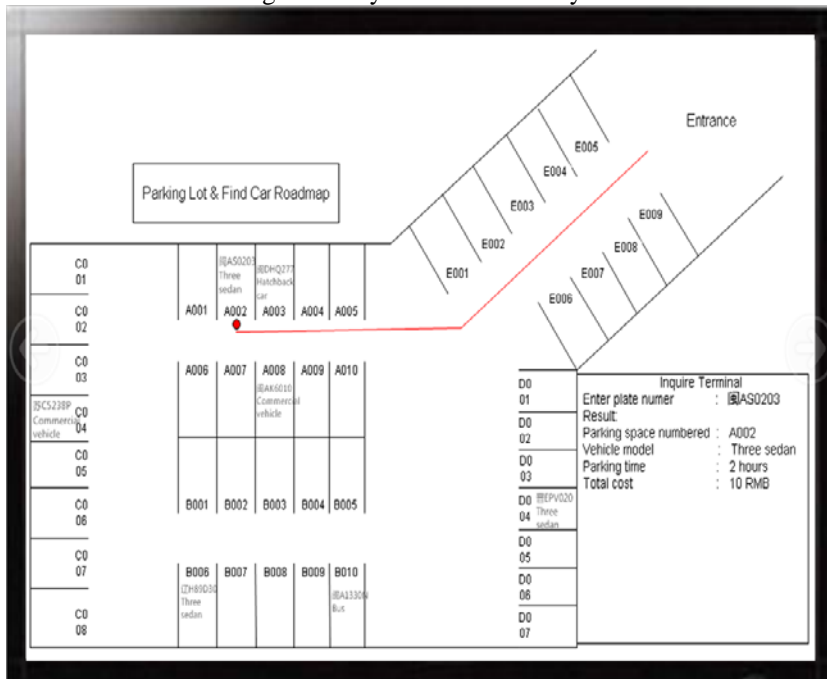


Fig.2. Touchscreendisplay

The layout of the entire system is shown in Fig.1 and ' ' represent CCD camera.

Parking space data acquisition module is used in aisles and each parking space to install a CCD camera, collecting the real-time images of parking space, provides data source for the subsequent operation such as vehicle plate and type recognition, vehicle movement track recognition [5] and so on.

Data transmission module adopts wire or wireless transmission to transfer the video to capture card, the analog signal will be converted to digital signal, and after compression the signal is transmitted to the processing terminal for processing.

Wire transmission mode is generally used in the case of that parking space and processing terminal is far away for wireless signal coverage, since cable transmission is relatively stable, long distance transmission.

Wireless transmission mode is used in a reliable wireless signal range, and it has many advantages such as saving the wiring, simple installation, flexible and convenient. The wireless transmission mode is used 1.2G or 2.4G which is decided by the specific parking circumstances. If there are more obstacles between parking space and processing terminal like walls and trees, using 1.2G band wireless transmitting and receiving module is a good option. 1.2 G spectrum is better than 2.4G spectrum because of strong power which makes signal stronger ability to penetrate the barrier and has better diffraction. Otherwise if parking space and the processing terminal are in an open area, 2.4G band can be used on an empty area. 2.4G frequency transmission distance is farther than 1.2G band. At the same time, 1.2G and 2.4G wireless transmitting and receiving module have nine channels, which can be selected according to actual situation based on appropriate transmission frequency of transmission.

Processing terminal uses tower server with high performance and fast processing speed to deal with the received data. And it connects touchscreen display and networks which make customers can retrieve information from parking space through touchscreen display or network.

Touchscreen display is shown in Fig.2 at the entrance of the parking lot. Customers can input their license plate number in the interface which can query the parking space number, vehicle type, the parking time, the total cost and so on. At the same time can show the parking lot and find vehicle road map, facilitating the clients to reverse the vehicle. In addition, the system records license plate number and vehicle type in a parking space, and clients can also see license plate number and vehicle type.

Software system

The software system adopts the combination of VS2010, Opencv and Oracle database. Main functions are realized for viewing real-time video frame from the cameras, vehicle license plate recognition, parking time records, parking space number, total parking space number, remaining parking space number and so on. Managers simply using software interface can view any parking spaces in real time, such as a parking space whether have a parking vehicle, and can know the vehicle license plate number, vehicle type, and the staytime to act as an electronic patrol and perform timing charging. It is convenient, quickly and efficiently to realize the intelligent management for parking spaces. The software modules are

shown in Fig. 3, for example, parking space vehicle detection, vehicle license plate and type recognition, customers reversing the vehicle and so on.

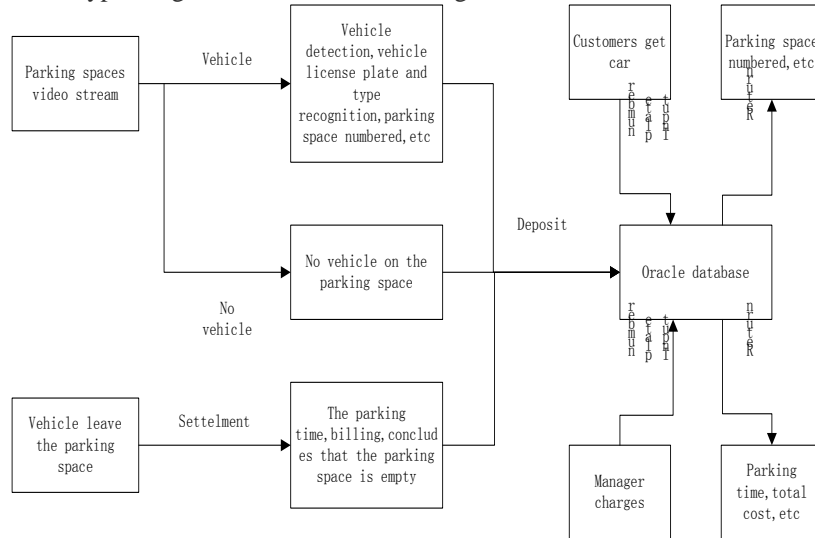


Fig.3. Modules for Parking space vehicle detection, vehicle license plate and type recognition, customer reversing the car flow chart

Our laboratory has been developing the license plate recognition program. The algorithm includes license plate image preprocessing, license plate location, license plate tilt correction, character segmentation and character recognition.

Vehicle type recognition in this design has been carried out by the team member Hao Chen and has been integrated into the system [6]. Vehicle type recognition is mainly divided into: three sedan, hatchback cars, commercial vehicles, bus, middle bus, minivan, truck, container truck in the system.

Vehicle movement track recognition in the design has been carried out by the team member Meiyang Lin and has been integrated into the system [7]. The algorithm can realize vehicle movement track recognition which is convenient for police to find the criminal.

4. Extensible function

This system has reserved module interfaces for the vehicle logo and color recognition which are undergoing projects that is aimed to realize the algorithms [8,9]. The system can set up a camera on each parking space to collect the owner's image if one wants to make the owner's face recognition. System reserved software and hardware interfaces, the new modules and algorithms can be directly embedded into the system to improve the reliability and security of parking management.

5. Conclusion

In this paper, the parking space intelligent management system is proposed based on visual identification in which vehicle information is extracted using visual image processing approaches according to data acquisition from different environment of a parking space by means of wire or wireless transmission, so that the system achieves more rapid, effective and intelligent. It is not only convenient for customers reverse their vehicles, but also for system administrators to manage parking fee and act as electronic patrol. The software interface implementation provides convenient operation, automatic controls so that labor costs are saving. At the same time, the reserved system interfaces can be used to extend the functions such as vehicle logo, body color and the face recognition to further enhance the reliability and security of the system.

Acknowledgments.

The authors gratefully acknowledge supports from Fujian Provincial Key Laboratory for Photonics Technology, the fund from the Natural Science Foundation of China (Grant No.61179011) and Science and Technology Major Projects for Industry-academic Cooperation of Universities in Fujian Province (Grant No.2013H6008), Fujian Province Department of Education (Grant: No.JA13073).

References

- [1] Faming Xiao, The scheme design of intelligent parking lot management system, China High Technology Enterprises, Vol.10(2012), pp.19-21. (In Chinese)
- [2] Jun Zhao, Zejun Liu, The Development of Management System of Intelligent Parking based on RFSN, Intelligent Computer And Applications, Vol.2(2012), pp.86-89. (In Chinese)
- [3] Lin Chao, Changyong Guo, Wendong Qiu, Wenqian Ma, Based on RFID and ZigBee technology integration of intelligent parking lot management system, Science & Technology Information, Vol.4(2013), pp.25. (In Chinese)
- [4] Jiannan Ma, Intelligent Parking Management System Based on the Atmega128 Single-chip Processor, Value Engineering, Vol.21(2012), pp.213-214. (In Chinese)
- [5] Meiyun Lin, Qingxiang Wu, Hao Chen, Movement Track Recognition System based on Spiking neural Networks, Journal of Microcomputer Information, vol.6-1, 2010, pp.177-179.
- [6] Nengsheng Pai, Shengfu Huang, Yingpiao Kuo, Chaolin Kuo, License plate recognition based on extension theory, International Symposium on Computer Communication Control and Automation (3CA), Vol.2(2010), pp.164-167.
- [7] H. Chen, Q.X. Wu, Y. Wang, M. Y. Lin, R.T. Cai, Identification of Vehicle Types based on Spiking Neural Network Model, Computer Systems Applications, Vol.20, No.4, pp.182-186, 2011.

- [8] YingyingNing, Wenju Li, Xinnian Wang, Method for vehicle-logo recognition based on principal components analysis and BP neural network, Journal of Liaoning Normal University(Natural Science Edition), Vol.33, No.2, pp.179-184, 2010. (In Chinese)
- [9] Guijun Li, Zhengxi Liu, Zhisheng You, Yong Zhuang, Car-body color recognition algorithm based on color difference and color normalization, Computer Applications, Vol.24, No.9, pp.47-49, 2004. (In Chinese)