

Study on the Identification System of Car License Plate Based on Imbedded Computer System

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Abstract—The automatic identification system of car license plate is a kind of computer system which can extract the character information of a car license plate from a car image in terms of computer vision technique, image processing technique and pattern recognition technique, etc. It is one of the important parts of realizing traffic management intelligentization. An automatic identification system of car license plate based on imbedded computer system applicable for intelligent traffic field is studied in this paper. Some relative algorithms are proposed to realize the partition of the car license plate characters. This paper also illustrates the hardware and software of the imbedded computer system in detail used to car license plate. As one of the important parts of the intelligent traffic system, the car license plate identification technique has wide future application and theoretical significance with the combination to the developing imbedded computer system.

Keywords—Imbedded computer system; Identification of car license plate; character partition; ARM processor; Linuxy

I. INTRODUCTION

With the continuous development of the national economy, car has snuck up on people's lives; vehicles on the road are more and more. Automobile traffic in this symbol of human civilization provides people with a variety of convenience; also bring troubles to the people, for mankind to a huge challenge. A modern transport needs modern traffic management, to address the traffic congestion and congestion status of the major cities and national highway sections and reduce accidents, illegally, to establish a modern transport command and control system is necessary. How to better manage and control cars on the road in order to effectively reduce the high incidence of illegal traffic incident has become an important task of transportation supervision departments.

In various types of intelligent transportation systems, the system is generally required to be able to state unattended 24-hour operation, the stability of the product work is very demanding, Job security features embedded products just can adapt to their stringent requirements in this regard. Intelligent Transportation Systems are used in a number of devices running on the outside, you must take into account the equipment in adverse weather conditions such as the

winter cold, summer heat, the South humid environments have normal and stable work, ability to adapt forcing environment is the work of intelligent transportation systems equipment selection in the first one important factor that must be considered, which is precisely one of the characteristics of embedded integrated products. The development of Intelligent Transportation System in various regions is different, as far as possible use existing equipment or system to strive for the smallest price to spend on upgrading existing systems or modules to add functionality. For embedded integrated product, the independence of its equipment enable it to be flexibly embedded into all kinds of application systems, as one of function modules for the new system significantly it reduces the overall system coupling, lower of its complexity and the probability of failure occurred to improve stability of the system and ease of maintenance; to transform and upgrade the old system, you can take maximum advantage of existing systems or equipment, add or upgrade a particular functional module in which the whole system is also only very small changes (such as the interface part, etc.), which brings about significant savings in overall investment, an increase of system benefits. As request of intelligent transportation systems and advantages of embedded systems products can be very well fit, embedded, intelligent integration of product applications in the field of intelligent transportation has been more and more people recognized. A growing number of users and professionals in the field of intelligent transportation are optimistic about the integration of products for embedded application prospects; there are many manufacturers in this area carried out product research and development.

License plate recognition technology can be widely applied to many practical vehicle management system, including: highways, bridges, tunnels and other automatic toll collection management systems; urban traffic management such as speeding and illegal vehicle identification, records, electronic police, Customs and Border Traffic monitoring, as well as the control area, important state organs and departments of the access control; intelligent community, intelligent car park management; license plate validation, stolen vehicle detection, tracking; traffic flow statistics and so on. Automatic Vehicle Identification System used in the

management system can automatically solve the wanted vehicle inspection issues; Can solve the traffic peak due to import and export traffic bottlenecks caused by road and bridge mount, Parking lot traffic congestion problems; can be solved due to fraud resulting from road and bridge staff card ports, highways, parking lots receivables problem of brain drain; can also use a simple manner in the transport sector vehicle information networking, resolve statistics automation, fuzzy query problems. It can be said that LPRS has a very broad application prospects.

II. LICENSE PLATE RECOGNITION ALGORITHM

2.1 algorithms constitutes

Automatic License Plate Recognition system is a highly intelligent comprehensive integrated system based on image processing, machine vision, pattern recognition technologies. A typical license plate recognition method is from Figure 1 into several parts.

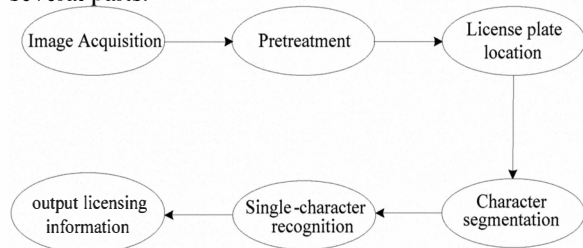


Figure 1 constitute a license plate recognition algorithm

The working principle can be briefly described as follows:

(1) The camera or the CCD camera captured the image containing vehicle license enter the host through the Data Acquisition Device Pretreatment. Preprocessing includes image gray-scale conversion and the necessary image enhancement, filtering, and image levels of correction etc.

(2) Positioning module conduct license search and detection locate and split out the characters that contains the license number of the rectangular region.

(3) License characters is separated out the two values of a single character, after normalized it can input character recognition subsystem identification; finally output plate number and the necessary additional information.

2.2 License plate location

(1) Based on color information. First, propose a color edge detection algorithm and then use the color edge detection combined with region growing to locate the license; use fuzzy function, in conjunction with color features to carry out license plate location. Color-based positioning method is a relatively new idea, because color images can indeed provide a lot of visual information, and often the vehicle license has a background different from the grades, body, and background. The disadvantage is that when the license plate background and body are the same, the error may be considerable, and this method which needs large amount of computing is relatively time-consuming.

(2) Based on the border information. After the image is subject to certain pre-processing, use Hough transforms to directly detect the license frame (outer contour) to locate a license plate. This approach has a serious drawback: Hough

transform is only applicable to binary images, if the two segmentation results are not satisfactory or license image border has been blurred, it is difficult to identify the straight line, and thus unable to accurately locate license plates.

(3) Based on horizontal or vertical direction histogram projection method. Mainly by using the characteristics that license character and background gray-scale contrast large, the license plate image vertical, horizontal projection, analyze projection crest and determine the location of license plate. Obviously, this method is only more appropriate to a larger proportion of the license, less background interference, and is general used in combination with other methods which will be better.

(4) The character-based edge and texture information. It should be said that a large part of the existing positioning methods are the use of characters in the edge and texture information to carry out license plate location, only the specific approach, criteria vary. Firstly use a first-order differential operator to get perpendicular edge image, and then use morphological closing operation to be a candidate license plate region, and finally distinguish genuine from candidate license plates; use wavelet transform to be the edge map, by selecting the appropriate structural elements expansion of operations has done for the edge map, then use license geometrical features to select real plates from the candidate area; first do edge detection, and then find the plate with projection method. The biggest advantages of these methods is fast calculation, the algorithm is relatively simple. But most of it are effected by automotive images, the background and the distribution of the same rich texture of non-plate region, location is not precise enough.

(5) Based on neural network approach. These methods can see neural network as a "filter", the method of direct perception license plates is used, that is by using sliding window traversal license plate image, the sliding window regional "sub-map" enter the trained neural network to determine whether it is the license plate. Different from them, the license plate is divided into 3 X 3 sub-graphs that will be sent to the neural network to determine whether the region of the sub-graph is color plates, and accordingly, mark the region, finally use projection method and in accordance with the plate length and width position a plate. In fact, this approach need combine the characteristics of license plates to carry out, its greatest advantage is a good anti-interference, a shortcoming is to calculate a large quantity.

(6) Based on transform domain approach. This approach essentially makes use of the license areas which has character-intensive, texture-rich features. As frequency-domain transform or other conversion domain computation is too big, applicability is not strong. Positioning need to calculate the whole image and the more pixels, in order to obtain a higher recognition rate, complex calculation is inappropriate. This chapter, we have characters and registration according to the gray background of license plates, features of characters and two-dimensional distribution, use sub-grid and secondary positioning methods, then present a balance between accuracy and rapidity of the license plate location method.

2.3 The license plate character recognition

At present, the character recognition in the field of pattern recognition has become an important branch, and like other pattern recognition applications, the basic idea of character recognition is also a matching discriminate: collect the expression on behalf of the nature of the unknown character-mode (such as the various features) and Pre-stored in the machine, the standard expression of a collection of character-mode (called dictionary) match one by one, with some discriminate criteria, the machine stores the standard character-mode forms of expression of the collection, find the closest expression of character-mode input, the expression of the corresponding word is the recognition results. Chinese license plate character recognition, include Chinese characters, letters and numbers to identify, where (ordinary cars, for example), the first one for the Chinese characters, is the provinces and municipalities short or branches of the short, the second for the letter, is the A-Z between uppercase English characters, the third and fourth for the letters or numbers, the latter three as the Arabic numerals among 0-9. However, different from other character recognition system it has its own characteristics:

III. SYSTEM DESIGN

The system design the license plate recognition system which can capture a real-time image of a section of highway, and then after processed by the CPU, locate and identify that there is a license plate, and finally display the plates information and send to Ethernet. Specific processes can be described as: the system first through the camera, dynamically obtain sections image, and send data through USB to the system memory; after CPU locate license plate, through computing and processing get any license plate information; Finally, display the plates information to the LCD, and through NIC license plate information will be sent to the server to prepare for query, match. In order to achieve these functions, the system apart from the basic interface unit, also needs storage space for expansion as well as auxiliary debugging interface. In summary, the system includes the CPU, memory modules, LCD modules, USB interface camera, network interface, JTAG interface, UART interfaces, LED, and buttons and other elements. UART, JATG interface is mainly used for system debugging and download process. Memory cell is used for storing data, including operating systems and applications. System function block diagram is shown in diagram 2.

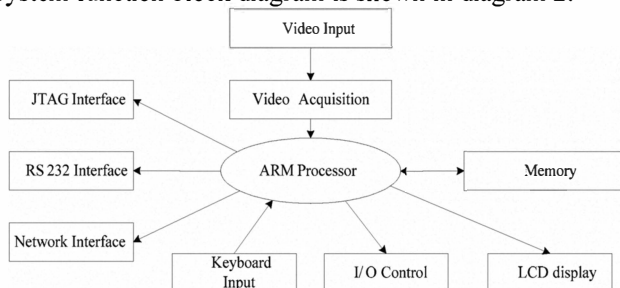


Figure 2 System Design Diagram

3.1 Hardware Design

The system has a lot of peripheral devices (network interface, USB interface, LCD interface, etc.), and Complex communication. It is a huge task to develop various of drivers and manage their communication completely on ones own, and it also required a long development cycle. Therefore, we choose an operating system to manage the coordination of system software modules. And the operating system comes with various drivers; developers need only a simple transplant, which greatly reduced software development time. However, running the operating system means requiring CPU a high-speed, system large storage space. ARM processor has 4G addressing space, fully meet the needs of storage space of loading the operating system; its 32-bit RISC features can also meet the system speed requirements. On the other hand, ARM processor, rich in natural resources, self-these major interface controller, is convenient in constituting the system.

ARM is a class of processors, but also a company's name. Company ARM (Advanced RISC Machine) set up in November 1990 in Cambridge, England, which is the world's leading provider of 16/32-bit embedded microprocessor and SC solution provider. Core technology of ARM microprocessor is widely used in portable communication products, hand-held computing, multimedia and embedded solutions fields which has become the standard of RISC. The core of ARM processor is the engine of the system, it reads instructions from memory ARM (32 bit) or Thumb (16 bit) and executes them.

Currently, the typical operating frequencies of popular ARM7 and ARM9 processors were 60M (<133M) and 200M (<266M). Taking real-time requirements into account throughout the system, we choose the faster ARM9 processor. It can easily run in Windows CE or Linux operating systems, and can carry out more complex information processing. We choose Samsung's high-cost-effective, low-power processor, 53C2410 in the design system. It consists of three parts: ARM9 TDMI, MMU and high-speed CACHE, Mainly own resources are:

3.2 Software Design for License Plate Recognition

Graphical User Interface (*GNU*) referring to a computer with a visual dialogue between the user interface, is an important component of a computer system. *GNU* pandemic today is one of the major achievements of computer technology, which will greatly facilitate the use of non-professional users, people needn't to memorize a lot of orders any more, they may easy to operate the system through the windows and menus.

Due to our limitations, we can almost see similar to the PC, the graphical user interface system in embedded systems, which is very appropriate for modern use and development of embedded systems. Whether in the industrial control, or consumer electronics products such as PDA and set-top boxes, a friendly user interface are required, so there appears a lightweight, taking up less

resources, high-performance, high reliability, configurable *GNU* system in the market.

At present, the popular *GNU* development tools in PC is mainly based on X system, with X Windows and Xfree86. Using a standard client - server architecture, X Windows system has the advantage of scalability is good, and good portability. But for embedded systems, the X Window System is too large, cumbersome, low efficiency, which is not suitable for direct use in embedded systems. The popular *GNU* standard in Linux is Xfree86, but this procedure bulky, low efficiency, which is not suitable for use in embedded systems. Although many organizations were cutting X, but if you add in library files and development kit, the entire volume is still not acceptable of

embedded systems. The popular idea of embedded *GNU* is different from X, which is based on FrameBueffer (frame buffer) basis. Currently, the typical embedded graphical interfaces implemented on the basis of frame buffer mainly are Micro windows, MiniGUI and QT / Embedded. Due to space limitations, detailed description of the system migration is no longer here, the license plate recognition software block diagram is given in the following.

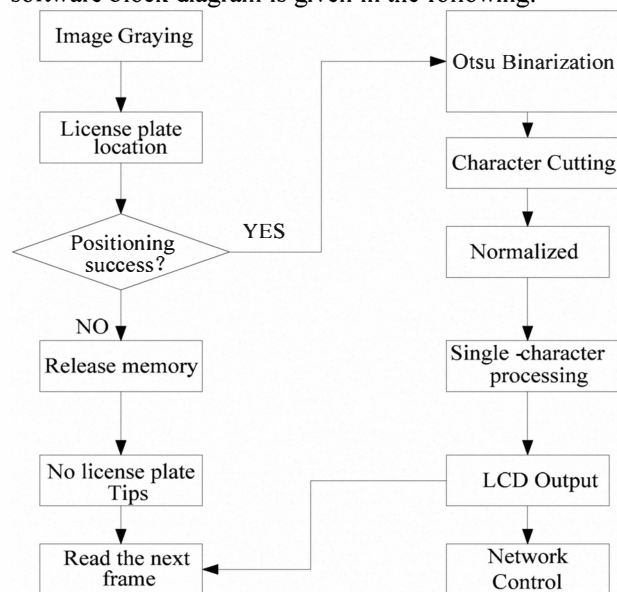


Figure 3 Block Diagram License Plate Recognition Software

IV. CONCLUSIONS

The study using the ascendant embedded hardware development of technology and performance of open-source embedded Linux operating system, associated development tools, combined with high-performance core of the vehicle license plate recognition algorithm, so the system is stable, fast, reliable, high performance and low cost, it will have broad application in the integrated information field.

Due to various constraints, there are still some shortcomings in the comprehensive information technology research. For an urgent requirement of modern traffic monitoring and management, so that it has great potential for applications. With the development of science and technology, embedded processors, storage devices and their associated peripherals are constantly manufacturing, powerful, inexpensive hardware at your fingertips; On the other hand, Linux has brought stability, multi-functional, open source and its progress for all to see. We can use our extraordinary imagination and creativity to design superior products for embedded license plate recognition and promote the development of the motherland transport and promote the progress of the world.

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