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Design of Inspection and Security Vehicle Checking System Based on Arm 7

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***Abstract* — Security system nowadays become a need for vehicles and available with many modern features. This car security system comes with extra secure access and message on GSM net. The system only can be accessed and configured by owner using GSM module communication via mobile phone. In this project, when the car is theft, an intruder alert message will be sent to the user's phone through GSM communication and GPS positioning. After the certain time, by using the GSM net and the GPS positioning techniques the probability of finding car where accident occurs or the car parked location will done easily. With ARM7 as the core, the new intelligent mobile vehicle checking system integrated a lot of hardware modules such as video capture, GPS positioning and wireless transmission, the design of the system software used the embedded software developing platform based on ADS integrated development environment. By the hardware/software co-design, the new intelligent mobile vehicle checking system implemented the functions of video capturing, intelligent plate distinguishing, GPS positioning and wireless transmission, met the traffic auditing department's needs about Mobile Vehicle Checking.**

***Key Words* — Mobile Vehicle Checking, Video capture, GPS, GPRS.**

I. INTRODUCTION

In the past decades, the issue of security has become more significant and the need for effective security systems has intensified [1]. Many areas were marked as restricted, since illegal access canhave serious consequences for homeland security and can even result in the loss of lives in the case of an explosive armed vehicle. To increase security in access control applications for a vehicle that enters a restricted area, this work proposes the architecture and installation of a vehicle inspection system. Three different computer vision applications are integrated in the system, namely license plate recognition, vehicle manufacturer/model detection and under-vehicle inspection. The systems use several vehicle features to identify the vehicle from different aspects and their combination could improve the overall system effectiveness and identify attempts of fraudulence, such as the use of stolen plates. Typical applications would include high-security areas such as airports, embassies, power plants and military camps. In these areas, registered vehicles are allowed to enter, where other vehicles are prohibited. In the literature, License Plate Recognition (LPR) remains the principal vehicle identifier. Systems of this type, detect the vehicle license plate, segment its characters and proceed to character recognition. Such systems are still widely researched and used, despite the fact that license plates can be easily altered in case of fraud. Fitting a piece of glass in front of the plate to cause light deflection and replacing the plates with stolen or counterfeit ones, are just a few examples. System effectiveness can be drastically improved if license plate recognition is combined with simultaneous vehicle manufacturer and model recognition. In the latter, recognition is conducted through the vehicle mask and the manufacturer logo and is based on machine learning techniques and artificial intelligence. These features can help to identify a vehicle with a tampered or stolen plate. With the development of technology, people have higher expectation of living, country has invested a huge amount of money to the capital construction, especially to roads infrastructure. In this situation, the roads infrastructure is developing fast, the highway mileage has enormous increase and there is an increasing number of vehicles on the roads. However, the huge number of cars raises problems of its own, there are more and more car thefts, lost and violations of rules which are given serious attentions. The time which is spent on checking on the roads by the department of traffic charge, check and police has been taken too much. Meanwhile, vehicles overload problem is getting worse around the country. Because of the merits of high capacity, large services and economy, public buses have become the main means of urban traffic. If the bus which took lots of people had a traffic accident, the result would be serious. The main cause of those serious accidents is overload; therefore, it is time to find some way to resolve this problem. However, most departments take care of this problem in traditional way, such as manual judgment and road checking. This traditional vehicle checking way has some faults such as leak checking, false checking, and is a heavy work for vehicle checking people, so it needs to find a intelligent mobile vehicle checking system to replace the traditional one. The new intelligent mobile vehicle checking system is designed to meet this need.

II. CAR MONITORING USING BLUETOOTH SECURITY SYSTEM

While normal wired security system normally used as a communication medium, wireless applications have been rapidly evolving in personal computing and communications devices. By using Radio Frequency (RF), it resulted in new way for people to communicate and gain access to data without the means of cables. The Bluetooth wireless technology was created to solve a simple problem or as an alternative replacing the cables used on mobile devices with radio frequency waves. Bluetooth is an open specification and the technology encompasses a simple low-cost, low power solution for integration into devices. Bluetooth operate at the globally unlicensed 2.4 GHz Industrial Scientific Medical (ISM) band that is available worldwide. [4] Bluetooth uses a technique called spread spectrum frequency hopping that makes it rare for more than one device to be transmitting on the same frequency at the same time. In this technique, a device will use

randomly chosen frequencies within a designated range, changing from one to another on a regular basis. In the case of Bluetooth, the transmitters change frequencies 1,600 times every second and it's unlikely that two transmitters will be on the same frequency at the same time. This same technique minimizes the risk another Bluetooth devices disrupt another Bluetooth network since any interference on a particular frequency will last only a tiny fraction of a second. [2] In term of level of Bluetooth security, in order to hack into a Bluetooth device, the hacker must achieve all these three hacking approach where it seem difficult to do such as force two paired devices to break their operation. Secondly hacker must steal the packets that are used to resend the pin and finally decoded the pin [5]. Furthermore, the hacker must also be within range of the device, and using very expensive developer type equipment. The "pairing process" is one of the most basic levels of security for Bluetooth devices. Pairing, is two or more Bluetooth devices that recognize each other by the profiles they share, in most cases they both must enter the same pin [6]. The core specifications for Bluetooth use an encryption algorithm, which is completely and entirely secure. Once the devices pair with each other, they too become entirely secure. Until they have successfully paired, the Bluetooth devices won't communicate with each other. Due to this pairing process and the fact that it is short range Bluetooth technology is considered to be secure. As indicated, experienced hackers have developed ways to get around this level of basic security first. We developed a wireless security system called Car Monitoring using Bluetooth Security System to secured car or vehicles. This device is equipped with PIR sensor and powered by 9 volt battery. This Bluetooth security system is designed by modules. It consists of hardware and software part. Using a modular approach, parts are easier to implement and troubleshooting can be done easily. Figure 1 shows the architecture of this device. It divided into two parts which is master and slave. The master part consists of mobile phone and its function for sending and receiving data through Bluetooth module by using some command which is programmed into PIC microcontroller. In this part, the master device will send out a continuous signal to slave devices. The slave part consists of PIR sensor, microcontroller, siren and Bluetooth module. The microcontroller acts as a brain managing input, output and how the system reacts upon event occurred. Bluetooth module functioned as communication medium between mobile phone and microcontroller. All the communication of Bluetooth module with mobile phone and PIC microcontroller are two way or bidirectional. Regarding on PIC microcontroller side, the communication responds are depending on software programmed inside. Any unrecognized codes or command sent will be ignored by PIC microcontroller. Additionally, the siren and motion detector physically had direct interface with microcontroller as they are in the one system functioning as input and output.

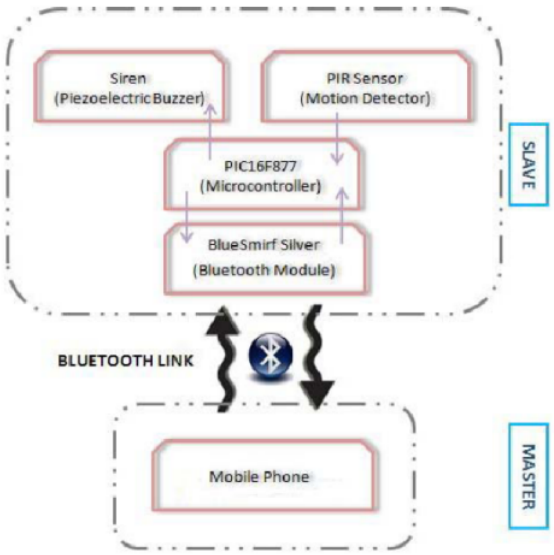

Fig.1. Car monitoring system based on blutooth

This security system has monitored only when the Bluetooth device is in discoverable area. In order to reduce this problem the arm 7 is building as the core instead of Bluetooth. The following paper contains the system composition using Arm 7

III. SYSTEM FUNCTION AND COMPOSITION

As shown in the figure 1, this system builds a new **intelligent vehicle checking system based on ARM7, embedded processing technology, processing technology of digital videos, vehicle identification technology, GSM wireless mobile telecommunication technology, GPS positioning technique, implements the checking** to vehicles which break the rules or owe the charge. This system has the following features.

A. Video Capture

When the system works, the camera in the front of the car collects the data automatically and saves it in the video buffer.

B. Vehicle License Recognition

The system recognizes the vehicle license by digital video data. By collecting the data it will store the license number and information of the car.

C. Communication Function

The vehicle checking terminal communicates with the server center by the SMS message on the GSM net.

D. GPS Positioning

The system can correctly send the position and time of the checking vehicle to the server center by GPS positioning, therefore, the terminals can be coordinated properly.

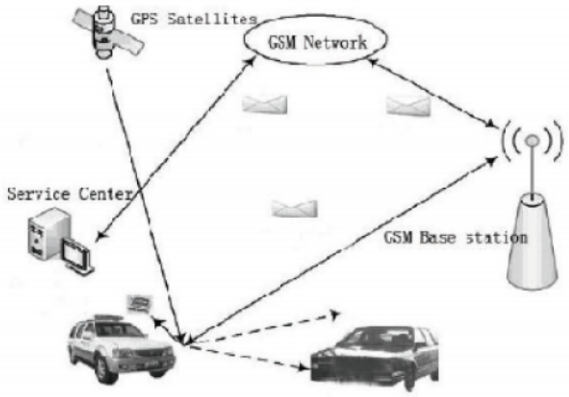

Fig.2. System Composition

IV. HARDWARE DESIGN

Intelligent mobile vehicle checking system is composed of ARM7 microprocessor, peripheral equipment, and video capture, GPS positioning module GS-216 m, wireless telecommunication module Q24PL002 and remote control receiver. The detailed hardware composition is shown in figure 2.

A. ARM7 Microprocessor and Peripheral Equipment

The circuit of ARM7 microprocessor and peripheral equipment includes a ARM7 chip, a clock circuit, a reset 115 circuit, a 32MB flash memory, a LCD. All of these make up the control and process core of the system.

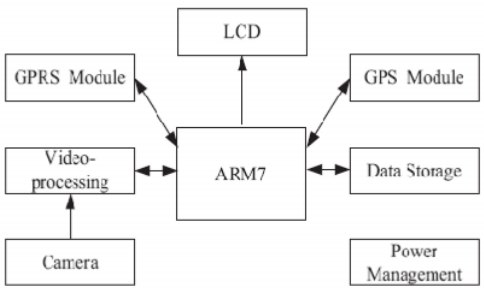

Fig. 3. Hardware Composition

B. Video capture

The video capture module includes: video decoder and output, data buffering and data transmission. The implementation-principle of video capture is shown in figure 3. The analog video signal captured from the camera is changed to digital signal by SAAA7111A signal-chip video decoder. The SAAA7111A signal-chip is initialized and controlled by ARM7. The SAAA7111A output data is written into FIFO buffer. The ARM7 generates interrupt when the data reaches a certain amount. The DMA is started after ARM7 interrupt and sends the video data into buffer.

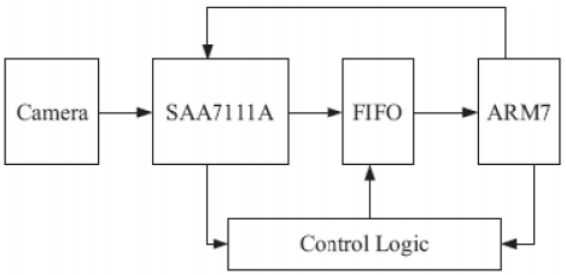

Fig. 4. Principles of Video Capture

C. Equation Output and Input of GPS Data

The GPS module in this system is GS-216m made by Gstar, Korea. The GPS module can receive the data by connected to ARM7 development-board URAT0 through RS232 port. When the ARM7 chip sends the instruction AT to GPS module, the GPS module starts receiving the data and saves it into memory. This instruction sends the region information with the vehicle license information to the support-server center through GSM net. Because the system is based on GPS data which is sent through GPRS net, it must be initialed at first. The initial instructions are following:

Reset
User settings initialized
Press ++++++□to enter the setup mode…Done
Init command List:
AT+ID=X CR
AT+IP=X CR
AT+PORT=X CR
AT+HTH=X CR
AT+BAUD=X CR
AT+APN=X CR
AT+AGREE=X CR
AT+REST=X CR

AT+ID=X: this instruction is used to set the terminal address. Each device must be set the address which indicates its ID, the default ID is 139XXXXXXXX. The default address is the SIM card mobile phone number which contains 11 numbers, the address can be changed as required.

AT+ID=? : This instruction is used to inquire the ID of the terminal. The instruction can be used to check whether the set of the device is correct.

AT+IP=X□ this instruction is used to set the IP address of the server in surveillance center. The format of IP is X.X.X.X. AT+IP=? □this instruction is used to inquire the IP address.

AT+PORT=X□this instruction is used to set the port number of the application software in surveillance center server. AT+PORT=? □this instruction is used to inquire the port number.

AT+HTH=X□AT+HTH=? this instruction is used to set and inquire the time intervals of the GPS positioning information which the terminals send automatically. The unit of the time interval is second.

AT+BAUD=X□AT+BAUD=? □this instruction is used to set and inquire the initial baud rate. The default is 4800 and does not need changing usually.
AT+APN=X□AT+APN=? □this instruction is used to set and inquire the connect port of GPRS telecommunication. The default value is CMNET.
AT+AGREE=X□AT+AGREE=? □this instruction is used to set and inquire the net communication protocol. The default value is TCP protocol. The terminal on car supports the UDP and the TCP protocol. Users can change the protocol as needs.

D. GPRS Wireless Communication

The GPRS communication device used in this system consists of Q24PL002 GPRS module made by Wave COM and the development-board. The GPRS module is installed on the development-board, the RS232 port on the development-board is connected to URAT1 on the ARM7 experiment & development board in order to implement that the ARM7 chip has control over the GPRS communication device. The GPRS device is controlled by the ARM7 through AT instructions. The GPRS device includes 24 operation instructions in common use, 10 talking operation instructions, 9 message operation instructions, 7 TCP/IP operation instructions. Some simple operations, such as signal strength checking, module vision checking, serial port baud rate checking, SIM card state reading, should be done when the GPRS device connects to the support server center. After making sure that the state which the ARM7 experiment-development board connects to the server center by the GPRS device is normal, the ARM7 chip outputs the AT instructions in order to send the vehicle-region information which is acquired by GPS module and vehicle license information which is acquired by vehicle-checking and distinguishing device to the server center through GSM net. After receiving the data, the server center compares the data with the black list in database and sends the result to the ARM7 experiment-development board through GSM net.

V. SOFTWARE DESIGN

The software of the new intelligent mobile vehicle checking system includes two parts, the remote-server center software and embedded terminal software. The development of the software is based on ADS integrated development environment.

A. Introduction of ADS Integrated Development Environment

The ADS integrated development environment is a microcontroller for ARM which is developed by the ARM Company, its full name is ARM Developer Suit and the mature vision is ADS1.2. ADS1.2 supports all the ARM microcontroller before ARM10, supports the software debug and JTAG simulate, supports the assembly language, C and C++ language. It has the merits of high compile efficiency and rich system libraries. The environment can run on Windows98 Windows XP Windows 2000 and Red Hat Linux.

B. Functions of the System Software and Implementation

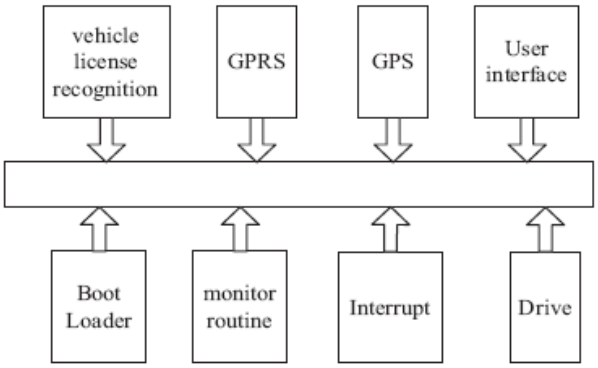

Fig. 5. Composition Software

1. Composition of Software:

The server center saves the data library which contains the newest vehicles in the 'black list' or the date from Q24PL002 into SD card. The video capture software collects the video data and changes its format, then the video capture software sends the data to the identification buffer. Date is sampled and sent to the vehicle checking software. The vehicle checking software identifies the vehicle license and compares it with the data in the SD card. If the car is the one which breaks the rules, the software displays the information of the car (include the license of the car, the name of the car and its owner). If the information is not in the SD card, the soft will inquire the server center and send the result to terminal.

2. Implementation

The design of this system software can be divided into four modules they are video capture module, vehicle license identification module, the graphical user interface module and communication module. The video capture module is executed in interrupt instruction, the vehicle license identification module and the graphical user interface module are executed in the main program and the communication module is executed in a program alone. The communication between each module depends on the message passing.

C. Development of interrelated software

1 Development of Boot Loader:

Boot Loader is a boot program which runs before the operating system nucleus. This program is on the entrance of reset, and implement the download and load of program.

2 Driver:

The abstraction level separates the part which depends on the hardware platform and makes the amount of work reach least .The driver just needs to design the codes which are relate to hardware, and provides a unified interface for the operation software. During the development of the embedded software used in the terminal, the driver of SD card, the driver of serial port and the driver of remote control are designed.

3 Identification Software:

The vehicle license identification module includes the region location of vehicle license, the pre-processing of the vehicle license image, the cutting up and Identification of the single character on the vehicle license. The software depends on the date to implement real-time Identification of vehicle license.

VI. CONCLUSIONS AND FURTHER RECOMMENDATIONS

This paper proposes the integration of a vehicle inspection system, which significantly increases security in vehicle identification by integrating different computer vision modules. Three different subsystem implementations were presented, namely the license plate recognition system, vehicle manufacturer/ model detection and under-vehicle inspection. The three distinct modules were analyzed and discussed. Results show that each method reaches good success rates, which in turn indicate that these modules can be used to boost the overall performance of an integrated platform for security inspection and access control. Finally, issues such as installation and operation principles were briefly discussed. The proposed system could be installed in entrance check points that require high security standards, such as government buildings, army camps or country borders and it can considerably facilitate prompt and effective vehicle inspection. Immediate benefits are the ability to reduce the number of personnel required to operate security gates, as well as to increase their level of awareness, while ensuring their personal safety. The new intelligent mobile vehicle checking system uses the detection technique of video capture, the wireless communication technique, meets the traffic auditing department's needs about Mobile Vehicle Checking. The system has the advantages of small size, low costs, full featured and powerful expansibility.

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