Real Time Anti-Theft Vehicular Surveillance System Using Raspberry Pi

Praveen UK[1], Ashique Mohammed M[2], Rajasekar.M[2], Mookaiah.S[2]

[1] *Assistant Professor,* [2] *Final Year UG Students*

Sri Ranganathar Institute of Engineering and Technology Athiplayam, Coimbatore, Tamilnadu, India

***Abstract*—Vehicle theft is one of the major problems what we are facing today. This paper deals with the design and development of an anti-theft surveillance system for automobile. The developed system makes use of an embedded system based on Raspberry pi. The designed and developed system is implemented in a Vehicle. The monitoring and controlling system in the installed device use GPS for positioning information, camera for monitoring the activities of the driver inside the vehicle and GSM/GPRS or information transmission. It acquires vehicle's location information (latitude longitude), video streaming after specified time interval. And transmit the vehicle's location and other information (including ignition status, video streaming, door open/close status) to the monitoring station/Tracking server after specified interval of time. The Developed web based software to display all transmitted information to end user along with displaying location of vehicle on a map and controlling information of the vehicle engine, it becomes more user friendly. The security system will warn the owner of the vehicle by sending SMS when there has been an intrusion into the vehicle.**

Keywords: **Real time surveillance, Raspberry pi, Vehicle detection, vehicle tracking.**

I.INTRODUCTION

Many people make the mistaken assumption that car theft only occurs in seedy areas of town, but car theft can occur anywhere from an urban area to a suburb. People need to be careful not to entice thieves by making common mistakes. Theft is one of the most common and oldest criminal behaviors. Where the ownership of a physical possession can be altered without the rightful owner's consent, theft prevention has been introduced to assert the ownership whenever the rightful owner is physically absent. An anti-theft system is any device or method used to prevent or deter the unauthorized appropriation of items considered valuable. GPRS and GPS based vehicle location and tracking system will provide effective, real time vehicle location, mapping and reporting this information value and add by improving the level of service provided. In tracking system a hardware device installed in the vehicle store GPS location, speed, USB camera and a trigger event such as key on/off, door open/closed.

A GPS-based vehicle tracking system will inform where your vehicle is and where it has been, how long it has been. The system uses geographic position and time information from the Global Positioning Satellites. The system has an "On- Board Module" which resides in the vehicle to be tracked and a "Base Station" that monitors data from the various vehicles. The On-Board module consists of GPS receiver, a GPRS modem. Generally ARM processor has the portability wit Real Time Operating System like Free RTOS, Embos and Linux. In this project ARM11 processor is used. This processor has the portability with Linux, Real Time Application Interface (RTAI) and many higher end RTOS with Memory Management Unit (MMU) and Memory Production Unit access. Interactive vehicle monitoring and controlling is developed with embedded web server using ARM RT Linux and Windows20013/2008 server as a service to communicate with tracking devices. The server software will listen TCP/IP ports, collect the data from tracking it on the data base. It must accept multiple connections at the same time. Web based frontend with user management system, hardware management system and an interface to show the data on the map software. Map software system should allow users to login and view their account with along in ID and password. Their tracking results (location/path of vehicle) will be displayed on mapping software such as google map or multi map etc.

II. RELATED WORKS

A. Anti-theft tracking system for automobiles (AutoGSM)

Ganesh.G.S.P., Balaji.B.,and Varadhan.T.A.S[8] proposed the Technology that achieves success only when it meets every stratum of people. Apart from the various GPS tracking devices this paper introduces a first of its kind vehicle tracking system that works only using GSM technology, which would be the cheapest source of vehicle tracking anti-theft system. It is a small kit that consists of a GSM module and several other components. The system can be switched ON by an SMS from the owner, which in turn instructs the microcontroller to turn OFF the vehicle, receive information about the vehicle's current location or more. Once this is done, the microcontroller stimulates the GSM module to forward the details of the nearest Base Station to the owner's mobile via text message. The microcontroller which receives the delivery messages through the GSM module evaluates the time gap between

successive messages to determine the exact location of the vehicle in a given area. The enviable advantage of this system is that it helps the owner in tracking the vehicle at a greater pace, and reduces the complexities comparing other system, besides being a cheapest alternative for anti-theft system as well.

B. Vehicle ECU Classification Based on Safety-Security Characteristics

Nilsson.D.K, Phung,P.H and Larson.U.E [4] developed a system for automotive manufacturers is to perform remote diagnostics and firmware updates over the air, which allows identifying hardware problems and correction of software flaws with minimal customer inconvenience. These procedures require that the previously isolated in-vehicle network permits external communication, which introduces a number of security risks, e.g., cyber-attack threats. In this paper, we identify cyber-attack threats and classify the electronic control units (ECUs) in the in-vehicle network to assist in determining which ones to protect and restrict access to. We divide the ECUs into five categories: power train, vehicle safety, comfort, infotainment, and telematics. We then use four safety integrity levels to classify the ECU categories. Moreover, we define safety effect levels of security threats which are used to classify identified attacks in the remote diagnostics and firmware updates over the air procedures. From the results we conclude that ECU categories such as powertrain and vehicle safety require further protection prior to introducing remote connectivity. As a conclusion, we suggest that automotive manufacturers should emphasize security or restrict the remote diagnostics and firmware updates over the air procedures to certain ECUs.

C. Engine Speed Control during the Gear-Shifting

Xiaofeng Yin , XihuaUniv, Chengdu,DianlunXue and Yun Cai[11]proposed a combined strategy to control the engine speed in such process, which overcomes the short comings of time-optimal control and fuzzy control while maintains the advantages of both through a mode switching mechanism in a combined controller. When the deviation between the control target and the actual control output is relatively large, the controller switches to time-optimal control mode; while the deviation is small, the controller switches to fuzzy control mode. The proposed strategy has been applied to engine speed control in the automatic gear-shifting process of an AMT test vehicle, which is testified to be efficient to reduce fuel consumption, engine noise, shift jerk, and clutch friction work by means of decreasing engine speed undulation and shortening gear-shifting time.

D. Embedded Web Server

Zhan Mei-Qiong and JiChang-Peng[14] Proposed the scope of embedded devices is increasing day by day and the demand will be further more when networking technology is incorporated into these devices, Here the proposed system consists of an ARM cortex processor LPC1768 with an integrated Ethernet interface and the whole system can function as a web server, Since ARM processor has fast execution capability and Ethernet standard can provide internet access with reasonable speed, this system is suitable for enhancing security in industrial conditions by remotely monitoring various industrial appliances where high safety and care is a necessity.

Embedded Technology is an emerging field day by day with a lot of possibilities. The single functioned, tightly constrained, reactive and real-time feature of embedded devices makes the life of man easier. By the arrival of Internet, the communication barrier of the entire world has reduced a lot such that the whole world has now become a single village. When the embedded devices are provided with internet access, it is doubtless that the demand will rise due to the remote accessing capability of the devices. the implementation of embedded networking is achieved by means of the embedded web server.

E. Streaming- Video Over In-Vehicle Wireless Networks

QiongLi ; BayerHealthCare,Tarrytown; Andreopoulos,Y. ; vanderSchaar,M[9] proposed that the State-of-the-art vehicles are now being equipped with multiple video channels for video-data transmission from multiple surveillance cameras mounted on the automobile, navigation videos reporting the traffic conditions on the planned route, as well as entertainment-multimedia streaming for passengers watching on rear-seat monitors. Wireless LANs provide a low-cost and flexible infrastructure for these emerging in-vehicle multimedia services aimed at the drivers and passengers' safety, convenience, and entertainment. To enable the successful simultaneous deployment of such applications over in-vehicle wireless networks, we propose delay-sensitive streaming and packet-scheduling algorithms that enable simple, flexible, and efficient adaptation of the video bit streams to the instantaneously changing video source and wireless-channel characteristics while complying with the a priori negotiated quality-of-service (QoS) parameters for that video service. In addition, the aim of this paper is to couple the proposed solutions with a novel multitrack-hinting method that is proposed as an extension of conventional MP4 hint tracks in order to provide real-time adaptation of multimedia streams to multiple quality levels for different in-vehicle applications, depending on their importance and delay constraints. First, the scheduling constraints for these simultaneous wireless video-streaming sessions are analytically expressed as a function of the negotiated QoS parameters. This is imperative because a video stream received from an in-vehicle road-surveillance camera will have a different set of delay and quality constraints in comparison to that of traffic monitoring received from remote video cameras located on the planned route.

III. SYSTEM ARCHITECTURE

In this design, we propose an extendable emergency response system for smart car to prevent them from theft using (ARM) processor. In this method, the Face Detection Subsystem (FDS) aims at detect somebody's face .By using PCA algorithm we can get the common eigen values of the person and it compares the image by finding the nearest value in some mathematical form. If the person matches vehicle starts or owner will get information of GPS values of the vehicle location in web. The applications of facial recognition range from a static, controlled authentication to a dynamic, uncontrolled face identification in a cluttered background. While the authentication performance of the face recognition systems that are commercially available is reasonable, they impose a number of restrictions on how the facial images are obtained, often requiring a fixed and simple background with controlled illumination.

The main idea of using PCA for face recognition is to express the large 10 vector of pixels constructed from 15 facial images into the compact principal components of the feature space. The relative simplicity of ARM processors made them suitable for low power applications. GPS, which stands for Global Positioning System, is a radio navigation system that allows determining their exact location, velocity, and timing 24 hours a day, in all weather conditions, anywhere in the world. GPS is used to support a broad range of military, commercial, and consumer applications. In this project. A wireless modem behaves like a dial-up modem. The receiver in the GSM module is mentioned as ignition unit. A GPRS modem can be an external device or a PC Card.

In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion. These all information's could be viewed and managed in the embedded web server.

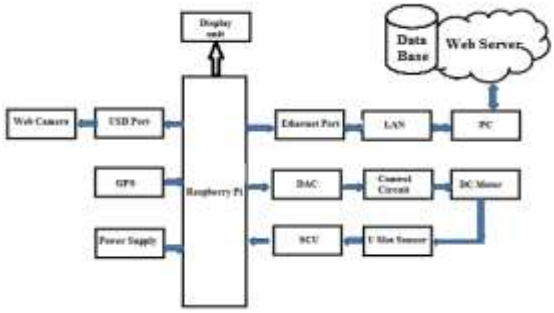

Fig 3.1 Block Diagram

A. GPS System

The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. The system provides critical capabilities to military, civil and commercial users around the world. A GPS receiver calculates its position by precisely timing the signals sent by GPS satellites high above the Earth.

The receiver uses the messages it receives to determine the transit time of each message and computes the distance to each satellite using the speed of light. Each of these distances and satellites' locations define a sphere. The receiver is on the surface of each of these spheres when the distances and the satellites' locations are correct. These distances and satellites' locations are used to compute the location of the receiver using the navigation equations. This location is displayed, perhaps with a moving map display or latitude and longitude. Many GPS units show derived information such as direction and speed, calculated from position changes. The current GPS consists of three major segments. These are the space segment, a control segment , and a user segment. GPS satellites broadcast signals from space, and each GPS receiver uses these signals to calculate its 3-dimensional and the current time.

B. GPS based vehicle tracking system

GPS vehicle tracking and navigational systems have brought this technology to the day-to-day life of the common man. Known by many names such as Automatic Vehicle Locating System, Vehicle Tracking and Information System

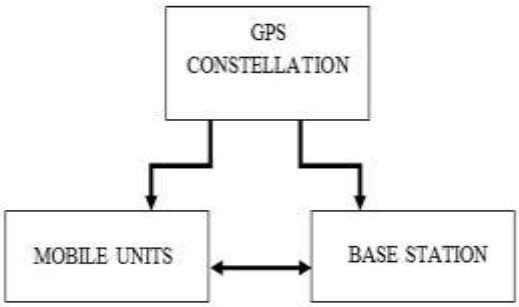

Fig 3.3 GPS Based VTS

Mobile Asset Management System, these systems offer an effective tool for improving the operational efficiency and utilization of vehicles. The switching off of SA has improved the accuracy of GPS to better than 30 meters, which makes it an ideal position sensor for vehicle tracking systems without the overhead of DGPS. Fig.3.7 gives the block diagram of a DGPS base VTIS.

GPS is used in vehicles for both tracking and navigation. Tracking systems enable a base station to keep track of the vehicles without the intervention of the driver where, as navigation system helps the driver to reach the destination. Whether navigation system or tracking system, the architecture is more or less similar. The navigation system will have convenient, usually a graphic, display for the driver which is not needed for a tracking system. Irrespective of the technology being used, VTS consist of three subsystems: a) In-vehicle unit (IVU), b) Base station and c) Communication link. The IVU includes a suitable position sensor and an intelligent controller together with an appropriate interface to the communication link.

Network Overlay Systems use cell phone infrastructure for locating vehicles. The cell centers with additional hardware and software assess the time of arrival (TOA) and angle of arrival (AOA) of radio signals from vehicles to compute the position of the vehicles. This information is sent to the tracking Centre through the cell link or conventional link.A more common technique used is direct radio link (DRL).

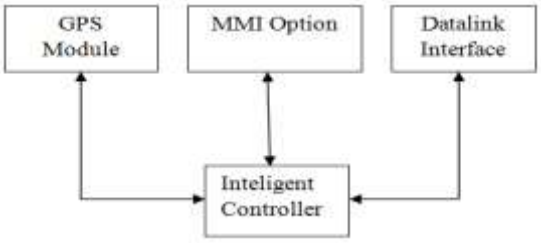

Fig 3.4 In-Vehicle Unit

The controller interacts with the GPS receiver, collects co-ordinates at predefined intervals, processes it and sends out to the communication link the base station consists of a high-speed system running VTIS application software that will receive the position data from the vehicles and display on a digital map. It too will have the interface to the communication link. The most costly part of a VTIS is the data link. When multiple vehicles are being tracked, a suitable communication protocol needs to be established to avoid collision of radio signal. The simple technique is TDMA, where each IVU communicates during predefined time slots. This synchronization is easy in a GPS based IVU as the GPS receiver provides very precise time reference signal. However, TDMA based systems have limited expandability, flexibility and are known for under-utilization of bandwidth.

C. Ethernet and LAN

Internet works on a set of protocols, commonly known as "TCP/IP" is the set of rules used as a standard to communicate between computers. TCP/IP can be used in addition to the existing set of LAN protocols to provide the ability for any machine connected to the particular LAN to communicate with each other. Ethernet is a Local Area Network standardized by the IEEE 802 committee originally conceived for the general purpose data transfer at maximum speed of 10 Mbps. The performances are increased by the introduction of switched. The fast Ethernet named as 100 BASE-T have been evolved for better performance with high speed.

D. USB Camera

The camera forms an integral part of the vehicle monitoring system in the vehicle unit. Whenever the engine starts the camera going to ON mode which initially capture an image and send it to the webpage then it changed to video mode, here it done video streaming and the information is continuously uploaded in the web using GPRS modem, it provides visual picture of the situation in which the system is shown in Figure 3.9 Software utilizes RPi GPU, so for example encoding h.264 video has low impact on CPU usage.

Many are supported by Video4Linux, which lets you use it with nice software like Motion and Streamers RPi does not have enough CPU horsepower to do higher frame rates, resolution, or advanced video compression. The Logitech C920 supports high frame rate hardware. To get a fresh install of Debian "Wheezy" onto an SD Card – this is obtainable from the Raspberry Pi website for free. This can be put onto an SD Card using Win32DiskImager for Windows. Without the external power boost, Pimay not be capable of powering the webcam on its own. it for about 60 seconds and then navigate to your Raspberry Pi's internal IP address. Make sure you include port 8081 at the end, as this is where your webcam images will appear. You can configure your setup in a web-based interface from now on by connecting to port 8080 instead of 8081. Types is /dev/video* into your terminal to find out the name of your video device. The default in the /etc/motion/motion.conf file is normally video so if you get a different output then it may require changing.

IV. RESULTS AND DISCUSSION

A. RT Linux Porting and Code Execution

The boot image must be loaded to ARM processor for start up the code and run the application. This is done by connecting the target board USB and changes the settings in HyperTerminal. It is shown in the below figures 4.1, 4.2 and 4.3.

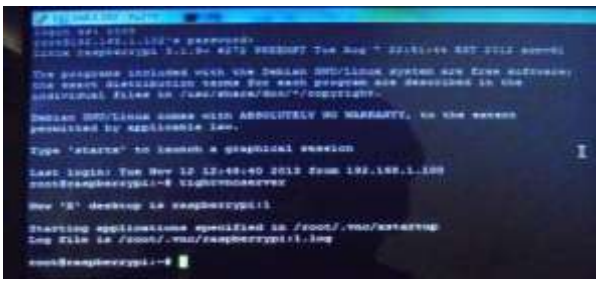

Fig 4.1 System Configuration

B. VNC Viewer and PuTTY Configuration

The VNC viewer and the PuTTY configuration is used to connect the ARM11 processor with the local area network and the display unit. IP address of the both VNC viewer and the PuTTY configuration are matched to create connection

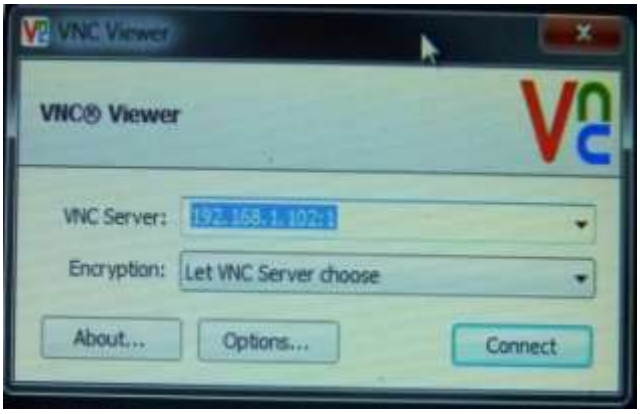

Fig 4.2 VNC viewer Configuration

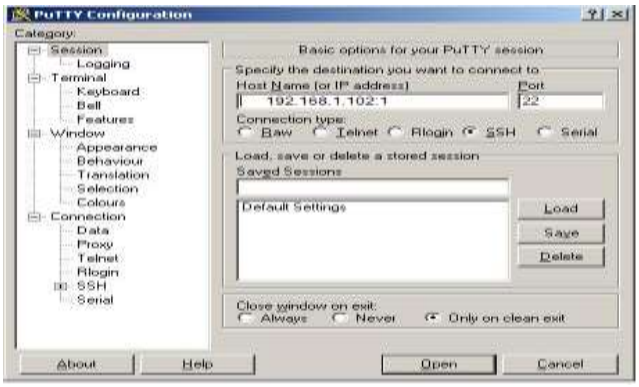

Fig 4.3 PuTTY Configuration

C. Execution in ARM11 Board

All Sensors will determine the moisture level, Humidity and Temperature at the irrigation zone. ARM11 processor should get sensor data per minute. Micro controller should analyze the data, take correct action and record the data. It is shown in figure 4.4,4.5 and4.6.

Fig 4.4 ARM11 processor

Fig 4.5 Hardware Module connection

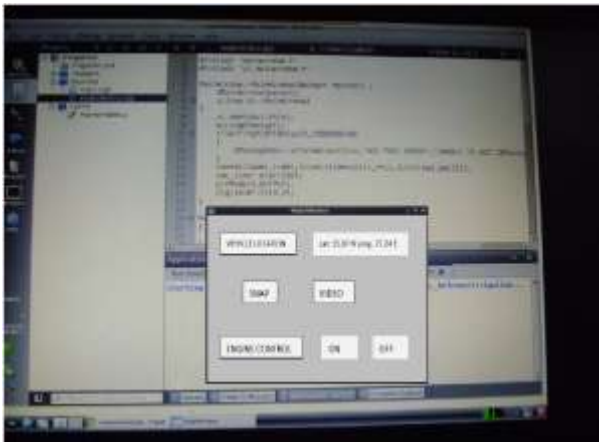

Fig 4.6 Output

V. CONCLUSION

In this project, the prototype for live streaming is done for monitoring the real time theft occurrence and the provision for managing the theft can be obtained. The USB camera is used to provide the snap of the user in the vehicle and the captured video is stored in the web server. The vehicle location can be identified with the help of global positioning system (GPS). Using GPS, the latitude and longitude of the current location for the vehicle can be displayed. The captured images by camera is compared with the images of authorized users, if the images vary it indicates the occurrence of the theft. Once the theft is identified, the vehicle's engine can be controlled by the authorized user i.e the owner of the vehicle. The controller works in both manual and automatic mode with respect to the user input.

FUTURE WORK

The future work can be done for the implementation of web server based control and real time data base management system using Microsoft structured Query Language, Automatic face recognition for theft identification and processing of data to the networked user nodes.

REFERENCES

[1]. Ambade Shruti Dinkar and Shaikh. S.A, (2011) "Design and Implementation Of Vehicle Tracking System Using GPS",Journal of Information Engineering and Applications, Vol.1,No.3, pp. 56 – 60.

[2]. Bretzner. L.Krantz, M.(2005) " Towards low-cost systems for measuring visual cues of driver fatigue and inattention", IEEE International Conference on Vehicular Electronics and Safety,Vol.02,No.02, pp. 161 – 164.

[3]. Chadil.N.,Russameesawang. A.,Keeratiwintakorn. P.,(2008), "Real-time tracking management system using GPS, GPRS and Google earth ", 5th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology, ECTI-CON 2008, Vol.1,No.04 pp. 393 – 396.

[4]. Chilsson.D.K.,Phung.P.H.,andLarson.U.E (2008)''Vehicle ECU Classification Based on Safety-Security Characteristics,'' IEEE Conference on IET Road Transport Information and Control , Vol.02, No.04, pp. 1-7.

[5]. Dr. Kamal Jain and Rahul Goel "GPS Based Low Cost Intelligent Vehicle Tracking System (IVTS)", 2012 International Conference on Traffic and Transportation Engineering (ICTTE 2012), IPCSIT ,vol. 26.pp. 192-195.

[6]. El-Medany. W.M.,Alomary. A.,Al-Hakim. R.,Al-Irhayim. S.,Nousif. M(2010) , "Implementation of GPRS-Based Positioning System Using PIC Microcontroller ",Second International Conference on Computational Intelligence, Communication Systems and Networks (CICSyN),Vol.03,No.04, pp. 365 – 368.

[7]. Fleischer.P.B.,Nelson. A.Y.,Sowah. R.A.,Bremang. A., (2012) "Design and development of GPS/GSM based vehicle tracking and alert system for commercial inter-city buses " , IEEE International Conference on Adaptive Science& Technology (ICAST) ,Vol.03, No.02, pp. 1 - 6 .

[8]. Ganesh. G.S.P. , Balaji. B., Varadhan. T.A.S., (2011),"Anti-theft tracking system for automobiles(AutoGSM)",IEEE International Conference on Anti-Counterfeiting, Security and Identification (ASID) ,Vol.02, No.01 ,pp.130-136

[9]. Qiong Li,Andreopoulos. Y.,van der Schaar. M., (2007) "Streaming-Viability Analysis and Packet Scheduling for Video Over In-Vehicle Wireless Networks "Vehicular Technology, IEEE Transactions on Vol: 56 , Issue: 6 , Part: 1, pp.3533 – 3549.

[10]. Wei-Bo Yu ,Dong-Yan Wang ,Ding-xuan Zhao,Yan-Qiu Huang (2007) " Study on the Improved Fuzzy Control Strategy of Engine Throttle Position Control System " International Conference on Learning and Cybernetics, Vol: 2, No.03 ,pp. 647 – 650.

[11]. Xiaofeng Yin ,DianlunXue ,Yun CaiFuzzy(2007), "Application of Time-Optimal Strategy and Fuzzy Logic to the Engine Speed Control during the Gear-Shifting Process of AMT ",Fourth International Conference on Systems and Knowledge Discovery Vol.0 4 , pp. 468 – 472.

[12]. Xing Jianping,Zhang Jun ,Cheng Hebin ,Changqing Li ,Shi Xiaohui(2008) ,"GPS Real Time Vehicle Alarm Monitoring System Base on GPRS/CSD using the Embedded System ",6th International Conference on ITS Telecommunications Proceedings,Vol.02,No.03, pp. 1155 – 1158.

[13]. Zhi Zhang , Wei Shangguan(2008). "Research and Design of GIS in Vehicle Monitoring System Gannan Yuan", ICICSE '08. International Conference on Internet Computing in Science and Engineering, Vol.02, No.02 ,pp. 223 - 228.

[14]. Zhan Mei-Qiong and JiChang-Peng (2008). "Research and Implementation of Embedded Web Server", International Conference on Multimedia and Information,Vol. 2, No. 3, pp.123-125.