

Design and Implementation of Traffic Monitoring System Based on Embedded Web Technology

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Abstract: The ever increasing number of vehicles in most metropolitan cities led to serious traffic congestion, accidents and an increase in the travelling time. So it is necessary to Implement of Traffic Monitoring System in order to resolve the traffic congestion on roads and reduce accidents. To exploit the technologies such as the internet, to design a Traffic Monitoring System that can remotely monitor and control a network of traffic. The system is based on utilizing Embedded Web Servers (EWS) technology to design Traffic Monitoring System and also use embedded Linux operating system. Remote monitoring is realized to traffic information collection, monitoring traffic conditions, traffic control, information published and communication of traffic data by using combining EWS technology with Internet.

Keywords: Raspberry Pi board, Ultrasonic sensor, Embedded web server

1. Introduction

With rapid economic development, transportation has increasingly become an extremely important component in the national economy and daily life. So it is very essential to build a modern traffic control system in order to resolve the traffic congestion of roads and reduce accidents. Traffic for solving urban traffic management has become the people's consensus such as advanced and sophisticated video surveillance system as an important component of transportation for image acquisition, on-site snapshot, after taking of evidence and other important tasks. And video monitoring and traffic information transmission in this system plays an important role. Monitoring systems are usually installed on the expressway, traffic junctions, toll stations and other key places according to the actual needs of current traffic monitoring. All the information is integrated to the monitoring center.

At present, the traffic management monitoring systems are based on the PC as a host computer, and deploy dedicated monitoring configuration software. This method is not only costly, inefficient, but also troublesome for the system to update, and specialized training for management personnel, and restricted by space-time and geography. Moreover, some information cannot be shared for public information service. With the rise of the Internet technology, embedded Web technology goes into the mainstream at present, and Web server support the program running on an embedded device. The managers can manage and monitor situations of traffic through the Web browsers.

This presents a method that combines embedded WEB technology with Internet to implement remote traffic monitoring through Web Server applications solidified in embedded ARM processor. Therefore managerial personnel can have the remote real-time monitoring of traffic management through Web browsers without time and geographical constraints as shown in Figure 1. Time-consuming effort of traditional local monitoring, as well as deficiencies in equipment maintenance, is effectively

overcome and efficiency of traffic management is greatly improved. In order to classify information, embedded Web Server applications consist of different treatments of classification according to the types of information that are then properly displayed in the browsers. Attention is given especially for the effective separation of the confidential and public information.

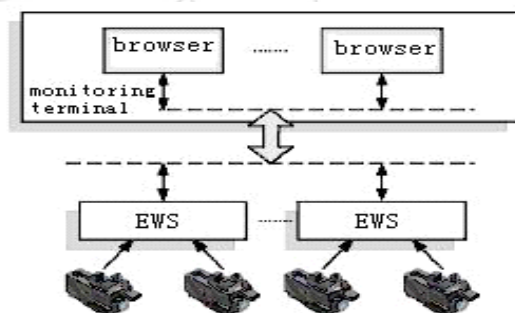


Figure 1: Embedded video monitoring system

2. System Design

Architecture of Embedded Web Server

A web server is a system which hosts a web site and provides services for any requesting clients. Fig. shows The design architecture of a typical EWS.

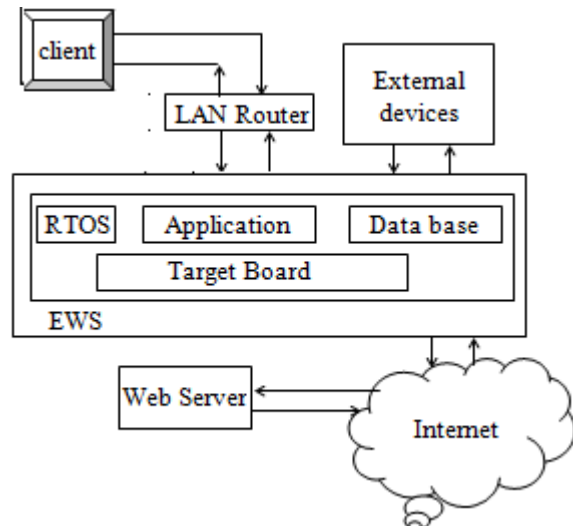


Figure 2: Architecture of a typical EWS

The hardware used for embedded web server is ARM11 based board. The board has the html pages saved on it. The application runs in the form of tasks. Each user connecting to the server is treated as a task. To manage the users, connections, an operating system is required, that performs the operations in real time. The embedded web server is a powerful but small RTOS kernel. It is highly CPU independent and has been ported to numerous microprocessor platforms. To interact with the clients, the client has to send the data to them. In the embedded web server, web pages are selected as the media of interaction. The web pages are designed using HTML.

Block diagram

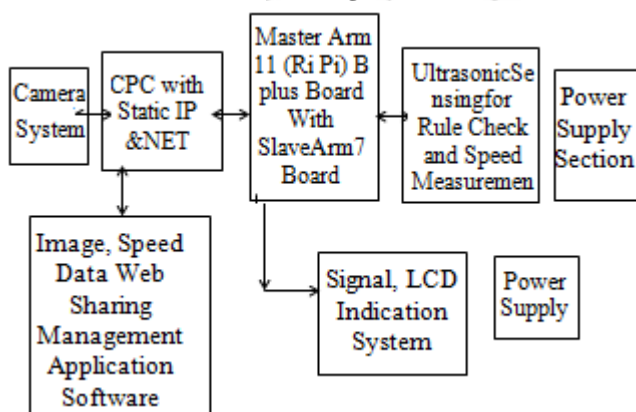


Figure 3: Basic Block Diagram

Details of hardware required:

1. Raspberry Pi:

The Raspberry Pi is an inexpensive ARM processor based single board computer running the GNU/LINUX operating system. It is powered by BCM2835 System on chip from Broadcom that contains an ARM processor running at 700 MHz. It has many peripherals such as USB master port, 10/100 Ethernet, HDMI and composite video outputs, and SD card slot. The Raspberry Pi has the microprocessor ARM1176JZF-S which is a member of ARM 11 family and has ARM v6 architecture. It has 256 MB of RAM and a few general input/output pins (GPIO) are available for low level interfacing with external electronic circuitry. Each I/O Pin can select a variety of electrical and non-electrical signals like current, voltage, resistance etc., Digital acquisition are

done by special ADC but in Arm11 ADC port is not present so that for data acquisition we use Arm7 board along with Raspberry Pi board. In this project Raspberry Pi board work as master and ARM7 Development Board work as slave.

2. ARM7 Development Board

The ARM7 Development Board comes with NXP's LPC2148 microcontroller. The microcontroller can be programmed through the serial port using the on-chip serial bootloader. The board features various interfaces available on-board like LEDs, Push Buttons, Analog Input, Dual-RS232 port, EEPROM, Power Amplifier, USB connector, Buzzer, Character LCD and dedicated connectors to plug-in a Temperature Sensor, Distance measurement sensor, Accelerometer, micro SD Card and an XBEE wireless device. A JTAG connector is also provided to enable programming and debugging of the microcontroller. The board can be powered using an external power source like an adapter or can be powered using the USB port on the computer. The ARM7 Development board has been designed for optimal use of the peripherals on-chip and interfaces on-board to create a variety of applications

3. Ethernet:

Ethernet is the networking technology used in many offices and homes to enable computers to communicate and share resources. Many Ethernet networks also connect to a router that provides access to the Internet. IEEE 802.3 supports a LAN standard originally developed by Xerox and later extended by a joint venture between Digital Equipment Corporation, Intel Corporation and Xerox. This was called Ethernet.

4. Ultrasonic sensor

The GH-311 ultrasonic Motion sensor provides precise, non-contact distance measurements from about 2 cm (0.8 inches) to 3 meters (3.3 yards). It has 3-pin male header used to supply power (+5 V), ground and signal. The header may be plugged directly into a breadboard or a standard 3-wire extension cable. It is very easy to connect to microcontrollers requiring only one I/O pin. The GH-311 sensor works by transmitting an ultrasonic (well above human hearing range) burst and providing an output pulse that corresponds to the time required for the burst echo to return to the sensor. By measuring the echo pulse width, the distance to target can easily be calculated

Features:

- High sensitivity, reliability, and stability
- 6 - 12 V supply power
- Sensing angle: no greater than 15°
- Sensing distance: 40 cm (max)
- Quiescent current : Less than 2mA
- output Level: High 5V
- output Level: Low 0V
- Sensing distance: 2mm-3m

Communication Protocol:

The GH-311 sensor detects objects by emitting a short ultrasonic burst and then listening for the echo. Under control of a host microcontroller (trigger pulse), the sensor emits a short 40 kHz (ultrasonic) burst. This burst travels through the air, hits an object and then bounces back to the

sensor. The GH-311 sensor provides an output pulse to the host that will terminate when the echo is detected; hence the width of this pulse corresponds to the distance to the target.

Software:-

1. RaspbianOS:

Raspbian is an unofficial port of Debian Wheezy armhf with compilation settings adjusted to produce code that uses "hardware floating point", the and will run on the Raspberry Pi. The port is necessary because the official Debian Wheezy armhf release is compatible only with versions of the ARM architecture later than the one used on the Raspberry Pi (ARMv7-A CPUs and higher vs the Raspberry Pi's ARMv6 CPU).

2. RTLinux:

Unlike Linux, RTLinux provides hard real-time capability. It has a hybrid kernel architecture with a small real-time kernel coexists with the Linux kernel running as the lowest priority task. This combination allows RTLinux to provide highly optimized, time-shared services in parallel with the real-time, predictable, and low-latency execution. Besides this unique feature, RTLinux is freely available to the public. As more development tools are geared towards RTLinux, it will become a dominant player in the embedded market.

3. Methodology

The embedded Web traffic monitoring system is based on embedded Web technology as the core. Meanwhile, it is combined with traffic information acquisition, traffic surveillance, traffic control, information publication and other traffic control functions. Then the traffic data are collected, stored, managed, transmitted, analyzed, and displayed. Complete project will be divided into two subsystems. First system will work at traffic signal to monitor the violation of red signal. In this, system will be using Raspberry pi board, camera and one ultrasonic sensor. As the traffic light turns red, ultrasonic sensor at signal unit will start detecting vehicle breaking traffic rule. If any vehicle breaks the red signal, it will be detected by ultrasonic sensor GH-311. At the same time camera will capture the photo of that vehicle and then send to monitoring center using web technology. Thus the system at signal unit will have all the database of vehicles those who have broken the traffic rule. Also, we will be using ultrasonic sensors to monitor the speed of vehicle. As soon as the vehicle will enter at particular road, first ultrasonic sensor will detect that vehicle and system will start the counter. Counter will get incremented until the same vehicle will cut the second ultrasonic place at particular distance from first ultrasonic sensor. Thus, we will have time taken by vehicle to pass thereby and distance travelled by that vehicle. Using the formula for velocity, we can calculate the speed of that vehicle. Thus, the system will be used to control various traffic rule breaks using Raspberry pi and other modules.

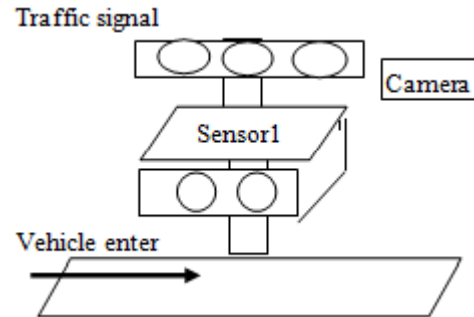


Figure 4: For Vehicle Detection

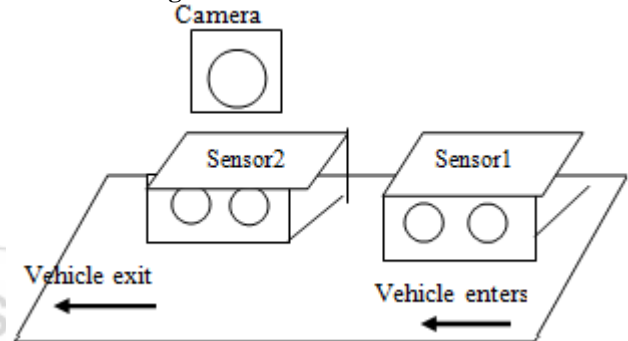


Figure 5: For Speed Measurement

4. Conclusion

The system adapts an embedded Web server technology to implement data collection and monitoring through using modular structure and heterogeneous network seamlessly connected. The traffic monitoring system based on embedded Web technology possesses the low power consumption, high integration, real-time efficiency and easy scalability. Also it is able to effectively manage the increasing complexity of system resources and makes some hardware virtualization.

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