INTELLIGENT VEHICLE NAVIGATION SYSTEM CONNECTED WITH INTERNET

Yi Bingxin, Zhang Qishan, Ding Shengxi

School of Electronic Engineering, Beihang University, Beijing, P. R.China, 100083

ABSTRACT

The intelligent vehicle navigation system is a multifunctional and complex integrated system that uses autonomous vehicle navigation, geography information, database system, computer technology, multimedia technology and wireless communication. In this paper, an autonomous navigation system based on embedded hardware and embedded operation system that is Linux is proposed. The system has advantages of low cost, small mass, multifunction and high stability, especially connecting with Internet.

KEY WORDS

Vehicle Navigation, Embedded System, Global Positioning System (GPS), General Packet Radio Service (GPRS)

INTRODUCTION

Embedded Systems are special computer systems that fit for strict applications on function, reliability, cost, volume, and power consumption. Embedded systems are found in a variety of common electronic devices including: (a) consumer electronics such as mobile phones, calculators and personal digital assistants; (b) home appliances such as microwave ovens, answering machines, and washing machines; (c) office automation such as fax machines, copiers, and printers;(d) business equipment such as cash registers, alarm systems and smart card readers; (e) automobiles such as transmission control, and vehicle navigation system.

We developed a new autonomous vehicle navigation system based on Linux, which uses GPS technology and the newest embedded technology. In this system, it utilizes GPS for positioning, which can offer all weather availability, highly precise positioning, strong anti-jamming and high secrecy. We also make use of Linux's opening and sustaining Internet, so that it can be easily connected with Internet and use resource supplied by Internet. So the system that we developed is so low cost, small volume and high reliability that adapts for the demands of the vehicle circumstance.

OBJECT OF THE EMBEDDED INTELLIGENT VEHICLE NAVIGATION SYSTEM

GPS is based on satellite navigation system. The system can offer whole globe, whole capability (land, ocean, aviation and astronautics), all weather availability for positioning, timing and measuring velocity. The intelligent vehicle navigation system integrates GPS, GIS, computer, multimedia and wireless communication technology, which can provide the driver all kinds of importance information and various effective services.

Vehicle navigation system has functions of positioning, map matching, information query, routes planning. In this system, we can use this vehicle navigation system as a computer terminal online by GPRS module. Thus we can solve the problem of software and map upgrade, and receive and send emails by GSM Net. Moreover, we can also use GPRS module as a remote monitor and annunciator. At the same time, it also can receive the traffic information that serves navigation better. The relationship of all function modules shows in figure 1.

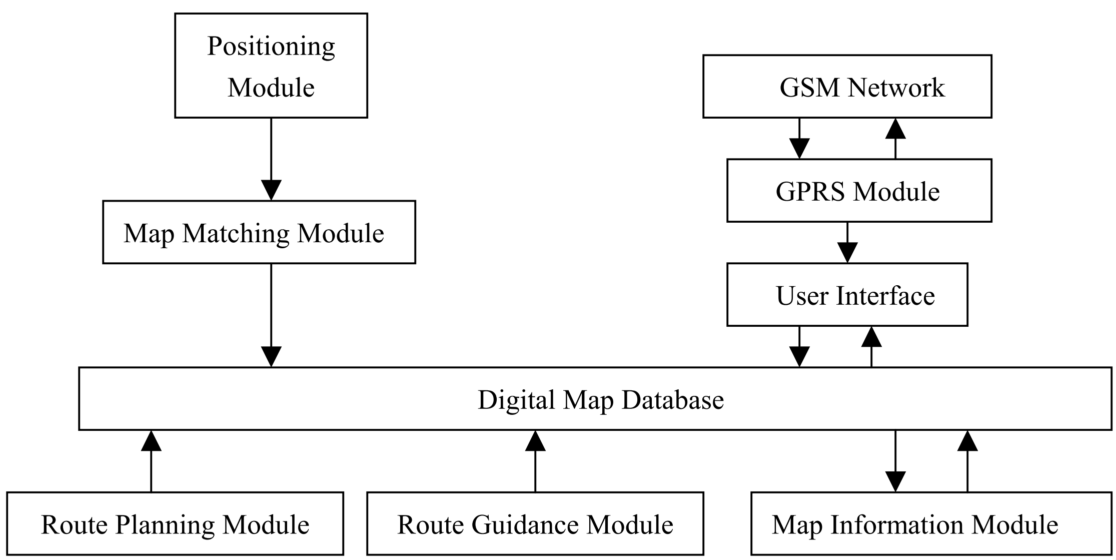

Figure 1 Intelligence Navigation System Function Frame

REALIZATION OF EMBEDDED NAVIGATION SYSTEM

Embedded systems have several common characteristics:
1) Single-function: An embedded system usually executes only one program repeatedly.
2) Tight constraint: All computing systems have constraints on design metrics, but those on embedded systems can be especially tight .A design metric is a measure of an implementation’s

features, such as cost, size, performance and power. Embedded system often must cost just a few dollars, must be sized to fit on a single chip, must perform fast enough to process data in real-time, and must consume minimum power to extend battery life.
3) Real-time: Many embedded systems must continually react to change in the system's environment, and must compute certain results in real time without delay.
4) a long lifecycle: Embedded systems are organically connected with special applications. The newer edition is offered with the newer product, so the embedded products must have a long lifecycle when they come into market.
5) Program solidification: For improving the executing velocity and system reliability, software of embedded systems usually is solidified in ROM or SCM, not in hard disks.
6) transparence: When embedded systems have been designed , they can not be modified by users without special tools and condition.

HARDWARE DESIGN OF EMBEDDED NAVIGATION SYSTEM

Based on intelligence navigation system functions and embedded system design demands ,the hardware is composed of Intel PXA250 and other peripherals, which includes memory system, LCD display, positioning module, touch panel, audio output, infrared remote control,wireless communcition port and so on.

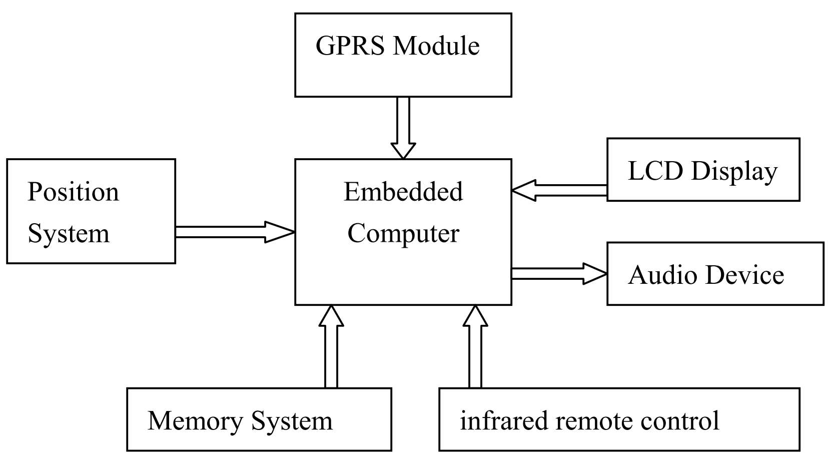

Figure 2 Intelligence Navigation System Structure

The CPU in embedded computer of the intelligence navigation system has characteristics such as smaller volume, lower cost and higher reliability than common CPUs. Intel PXA250 is a 32-bit RISC CPU offering a high efficiency power manager system, whose main frequency is up to 200MHz.

Positioning system makes uses of GPS/DR positioning modules to acquire position information, so that improves positioning precision. When GPS is not available, we can use the absolute position as the start point that was offered last time to compute the position of vehicle by a velocity sensor and an angle velocity sensor. When GPS is available again, GPS receiver can seizure the satellites at current position.

The memory system uses ROM or FLASH to save the application program and operation system, compact FLASH to save map information. It does not use big volume and heavy weight hard disk. Today the CF technology is more and more mature, and the volume is bigger and bigger. At the same time, the CF price is cheaper and cheaper .On the other side, we only need change CF to modify map information so that navigation systems can be used in different cities easily.

The user interface includes a LCD display, audio equipment and an infrared remote control.Users can handle the navigation system by the infrared remote control,and the result is showed for users on the LCD display. Also users can acquire sound information of navigation with the audio equipment.

Because the volume of memory system is limited, and drivers may encounter emergent incident such as theft and accident. Wireless communication is proposed in the intelligence navigation system. Therefore, GPRS is employed to connect GSM network and Internet. The main benefits of GPRS are that it reserves radio resources only when there is data to send and it reduces reliance on traditional circuit-switched network. The vehicle navigation system can download the newest map data of current city on website, transmit real-time information to center station and communicate with police office and hospital by GPRS. We choose MC35 produced by Simens as communication moudle. MC35 can be used as a GSM and GPRS module. With MC35, we can realize these functions.

The intelligence navigation system, which has the structure above, can not only meet the system functions, but also reduce its volume and weight. Thus it can meet the demands better.

SOFTWARE DESIGN OF THE EMBEDDED NAVIGATION SYSTEM

When we design the software of the intelligence navigation system, it is importance for us to choose what kind of embedded operation system to use. Generally, the common relevant metrics we must consider include time to market, transplant, resource available, customization, cost and support Chinese.

Now in global embedded software products, the sub-company of 3Com---PalmOS occupies 50 percent (3Com do not provide licenses except 3Com), and Windows CE occupies 29 percent. Navigation systems ask for a lot of functions so that embedded operation systems must have high performances. That makes cost so high that not all can accept. Windows CE has a lot of resources and can meet our demands. It is a tidy Windows 95. So the most attracting is that we are familiar with Windows. Thus we can grasp Windows CE so fast that products can be put into market earlier. But it is not free that we must pay for it when we use it. Moreover, Windows CE is not a good embedded system in technology. Because embedded systems pay more attention to personality, but Windows CE is not an open operation system that the third one has difficulties to customize products.

Embedded systems pursue high efficiency, low power, but Windows CE is not. It occupies much more memory and its application program is big.

As second generation, Linux is another attractive choice for embedded operation systems. Just as Unix, Linux is based on the kernel, which is an operation system of whole protect memory, multi-task and multi-routine. The kernel supports a lot of computer hardware including X86, Alpha, Sparc, MIPS, PPC, ARM, NEC, and MOTOROLA. All in all, the source code is open, and everyone can modify and releases it by GNU. Then developer can customize the operation system without worrying about the danger of “back door” like MS Windows. At the same time, products developed are compatible with GPL. When one has problems, he can ask thousands of Linux developer for help on Internet. That makes the most difficult problem be settled more easily. Linux is developed on Internet, so it offers a strong network function. Furthermore, it has many window managers (X windows), strong language compilers including gcc, g++. These compilers not only are mature and perfect, but also can be expediently used. Linux not only has a lot of resources applied like Windows CE, but also has advantages in customization because of the source code opening. From the angle of cost, Linux is free. That is more attractive for developing countries.

All in all, the main causes that Linux is applied in the embedded intelligent vehicle navigation system are:

First, Linux has a good availability. It has been customized in much equipment. That attracts research projects that are limited to cost and time. Prototypes can be developed on the standard platform, and be customized to hardware. That can accelerate the development of software and hardware.

Second, Linux can be configured free without limits of license.

Third, Linux is free. That can save a lot of developing cost.

Fourth, Linux supports TCP/IP network. With GPRS, an IP data transmission protocol being introduced to GSM. So we can use GPRS module as the transmission tool.

The navigation software is based on map information system, which is scheduled by the main application to deal with the positioning module, map matching module, the route planning and route guidance module, the GPRS module and the infrared remote control. The most important characteristic is intelligent navigation. We use rapid best route search algorithm, dynamic navigation route updating algorithm and map database technology, and make use of multimedia as output so that the interface is direct and lovely. Operation of the system is easy and concise. Functions are abundance.

FOREGROUND AND VIEW

Intelligence vehicle navigation system will be an important part of vehicle in the future, which can receive real-time traffic information by the wireless communication port. It can offer more exact and circumspect service for divers. Moreover, its functions include surfing and messages manage. It also can receive voice demands of drivers that can ease operation.

With the development of China economy and improvement of people's life, the whole society demands to high efficient and convenient traffic service are bigger and bigger. Therefore, the market of intelligent navigation is wide.

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