REGIONAL COUNTRY INFORMATION SERVICE PLATFORM BASED ON HYBRID NETWORK

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Abstract: In view of the current situation of the country where basic facilities are lagging and inhabitation is dispersed and the weaknesses of the various rural information technologies, a multilayered, distributed and regional country information service platform based on wireless field-bus hybrid network is proposed. Its structure, hardware frame and communication mechanism based on its application in a village are analyzed. The research shows that the platform can solve the 'the last one-kilometer' problem in China's rural informatization and thus has significant popularization value.

Key words: hybrid network, information service platform, rural informatization

1. INTRODUCTION

In recent years, China has made great progress in rural informatization (RI) construction, however it hasn't found a good solution to the issue of 'the last one-kilometer', and as a result, agricultural information cannot reach farmers quickly and effectively (Chen, 2006). There are various existing in the service platforms of our present rural information technologies like Short Message Service (SMS) (He, 2005), accessing internet via dial-up, Asymmetrical Digital Subscriber Loop (ADSL) and Cable Antenna

Television (CATV), especially high running expenses, complicated operation and poor interaction. Therefore, it's highly necessary to develop a technology that is suitable for RI.

Field-bus has the advantages of good interoperability, decentralized control function, easy maintenance; and wireless communication shows the advantages of low cost, short construction period and expandability. Hybrid network can bring out the advantages of each network and expand application range of the system and get high performance index (Vitturi, 2005). The multilayered, distributed and regional country information service platform based on wireless field-bus hybrid network that is to be discussed in the paper can adapt to the rural areas where basic facilities are lagging and inhabitation is dispersed. The platform gives farmers access to all kinds of agricultural information like dated agricultural condition and has functions of browsing, query and ordering, besides, it provides interaction functions between farmers and agricultural information system as well as among farmers.

2. REGIONAL COUNTRY INFORMATION SERVICE PLATFORM BASED ON HYBRID NETWORK

The platform adopts the hierarchical hybrid structure of wireless and field-bus technology (see figure 1), with the upper level adopting wireless communication technology network and the lower level adopting field-bus network. The platform is consisted of information center, information host and terminal.

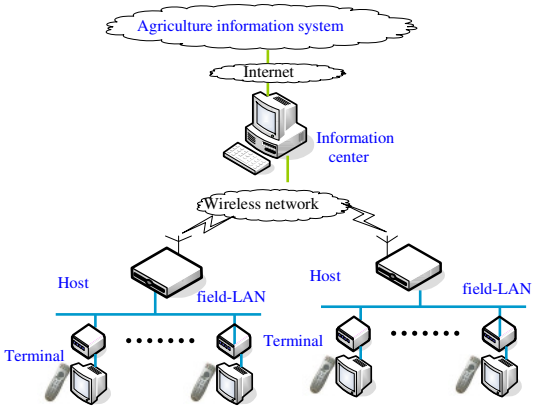

Figure 1. System structure graph

Information center communicates with all agricultural systems through internet. Having got the agricultural information, the center stores it in local database and then sends it to information host through wireless network. After receiving the information, the host stores it in its memory and forms field-LAN together with terminals through field-bus. Placed in farmers' houses and operated through infrared controller, the terminals acquire information from the host and send it to TV set in the means of video signals.

The platform is applied in a village of Qingyuan City, Guangdong Province. Placed in the office of the Village Committee, the information center gets agricultural information through internet and manages 10 field-LANs. Each field-LAN is formed by one host and 60 terminals. In its application, the distance between host and terminal can reach 800m, and the distance between field-LAN locations can reach 1000m. The entire platform can cover a village with a 3600m diameter, providing dated agricultural information for 600 farmers.

3. SYSTEM DESIGN

3.1 Hardware Design

At present, there are different types of long-distance wireless communication technologies such as GPRS/CDMA, Wireless Digital Transmission, WLAN Bridge, while the low-cost field-bus has RS485 and CAN, *etc*. In consideration of cost and distance, the long-distance wireless network is constructed by using CC1000 digital transmission module with 12dB outdoor omni-directional antenna. CC1000 is an ultra low-power consumption transceiver designed by CHIPCON. It is intended mainly for the Industrial, Scientific and Medical (ISM) and Short Range Device (SRD) frequency bands at 315,433,868 and 915MHz. It can realize wireless digital transmission between two facilities through RS-232 interface by relying on a few external components. Field-bus network adopts two-wire RS-485, which shows the characteristics of long-distance (the length of cable can reach 1200m at 100Kbps rate), multiple-node, low-cost transmission, and is also good at preventing common-mode disturbance (Dong, 2002).

Host and terminal adopt LPC2131 processor based on ARM7TDMI, which has small encapsulation and low power with high-speed Flash memory and several 32-bit timers, 47 GPIO and 9 edge- or level- triggered external interrupts. As illustrated in figure 2, information host is mainly consisted of processor, power circuit, memory, field-bus circuit, wireless communication circuit and LED display circuit. Processor receives

information from wireless module and stores in RAM, at the same time it communicates with each terminal through field-bus. As illustrated in figure 3, terminal hardware includes the same components as host except that it has output circuit, buzzer and infrared receiver module rather than external memory and wireless module. Video output interface connects with AV interface of TV set, buzzer signals new information or alarm, infrared receiver module receives controller signals and LED signals operation and communication. The terminal is a thin client who can decrease the cost.

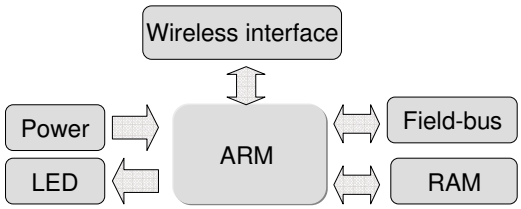

Figure 2. Host hardware frame

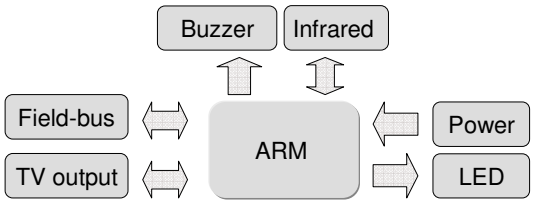

Figure 3. Terminal hardware frame

3.2 Software Design and Information Communication Mechanism

Host and terminal adopts uC/OS-II operating system, which is an open-coded, solidifiable real-time multiple-task operating system (Jing, 2006). For most distributed systems, their communication task is sending orders and collecting data by upper-level information center, but for this platform the main task is receiving orders from terminals by information center and sending out huge number of data completely and correctly. So the key of the software design is to ensure integrality and accurate transmission of the huge amount of information in the hybrid network

Time synchronization is the basis in realizing each communication task, and it is realized through the following steps in this platform: each host renews its time after reading the time record in the information center when

it is charged with power; then the terminal reads the time in host and renews its time record. Finally the communication mechanism between information center and host as well as between host and terminal is design to ensure integrality and accuracy of the information in transmission.

1) Information Center-Host Communication Mechanism

Because there is the possibility of drop net and power-off, there exists the problem of missing information from off-line host if the information center adopts broadcasting mode. Therefore point-to-point polling mode is adopted. Every piece of information includes issue time, save time, type, content, grade and verification. Issue time means the time when the information is put in; save time refers to the time when the information is saved. Time is saved in double-precision floating point, according to which data is sorted, searched and queried. Type is divided into common type and urgent type.

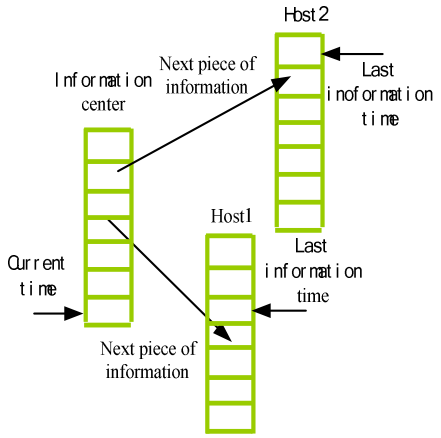

Figure 4. Information mapping method

Last information time refers to the save time of the last piece of information received by the host. As illustrated in figure 4, the information center stores the information in local-time sequence database after receiving it from each agricultural information system, and searches for the next piece of information and sends it to the polling host according to the last information time. When the memory is full, new pieces of information replace the earlier ones. Figure 5 demonstrates the flow chart between information center and host. First, information center inquires host and if there is no answer it then inquires the next one; then host uploads information packet, otherwise it sends out local information time; after information center gets response, it sends urgent information if there were any, otherwise it searches the piece of information next to the local last information time, then it inquires the next host. After polling all hosts, it

starts from the first one again. After receiving new information, host verifies, stores and renews last information time.

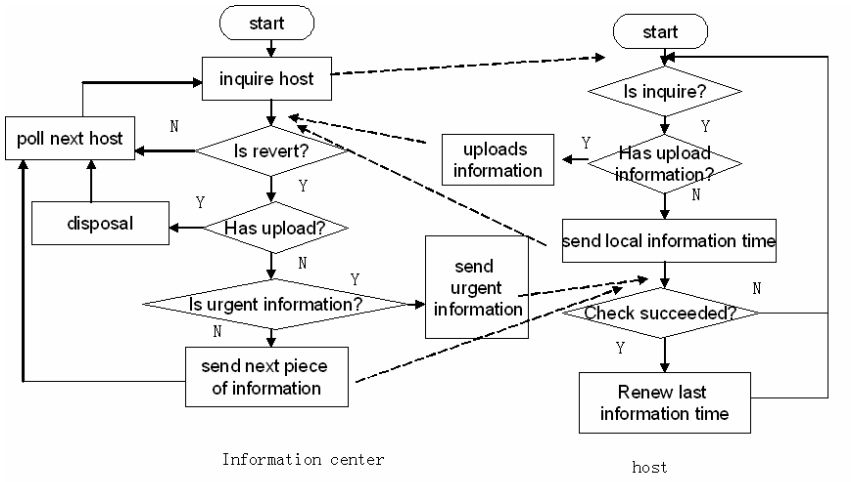

Figure 5. Flow chart of communication between host and information center

2) Host-Terminal Communication Mechanism

The communication mechanism between host and terminal mainly adopts master-slave mode, with the host as the master and the terminal as the slave. The host adopts time-sharing polling scheme, and polls one terminal every 50ms, that is, it can poll 20 terminals every second. The terminal doesn't store information and acquires data from host according to farmers' requirements in the time of polling, and sends it out in the means of video signals. Every terminal can acquire 120 characters every time at the rate of 19.2kb/s. Figure 6 shows the display result of terminals.

Figure 6. Terminal application

4. CONCLUSION

The current agricultural information technologies show respective weaknesses in their application in the rural areas. Mobile phone short message service, which uses mobile communication network as the communication platform and receives message through mobile phone, has the advantage of wide coverage and easy operation, yet on the other hand it has high cost (every family needs to pay (50-100) Yuan per month if it receives 1000 messages per month), limited information volume and monotonous information presentation. Publishing information through CATV network, broadcast television service shows the characteristics of diversified presentations, but it has to occupy TV channels, has poor interaction between information and users and cannot store the information. Besides, every family needs to pay (10-20) Yuan per month. Accessing internet via dial-up or ADSL has powerful functions but has high cost and complicated system operation, every family needs to pay (80-100) Yuan per month. The platform proposed in this paper adopts hybrid network and shared network access, and each family only needs to pay (2-5) Yuan per month. Therefore it has great advantage comparing with the methods above.

Regional country information service platform based on hybrid network is suitable for the application in the rural areas in China and other developing countries with low-cost, convenient operation and flexible network.

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