

Design and Implementation of Portable Agricultural Product Holographic Market Information Collection Terminal

XU Shi-wei^{1,2}, KONG Fan-tao^{1,2}, LI Zhe-min^{1,2}, LI Zhi-qiang^{1,2}, ZHANG Yong-en^{1,2}, Lv Ying³, TIAN
Zhi-wu³, WANG Dong-jie^{1,2}, YU Hai-peng^{1,2}

- (1. Agricultural Information Institute, the Chinese Academy of Agricultural Sciences, Beijing 100081, China;
2. Key Laboratory of Agri-information Service Technology, Ministry of Agriculture, Beijing 100081, China;
3. Beijing Global Safety Technology Co.,Ltd, Beijing 100085, China)

Abstract: This paper developed a Portable Agricultural Product Holographic Market Information Collection Terminal (APIC) which collected the holographic market information of agro-products, to address the issues such as undeveloped agricultural information collecting method, nonstandard collection criteria, imperfect classification and coding, as well as the lack of information collection device etc.. In the APIC system, there are two industrial standards on agro-product information collection embedded technology, and GPS positioning, integrated together with the general packet radio service (GPRS) and 3G mobile communications technology, making use of component development technology and embedded development technology, in order to achieve the standardization of data collection, instant transmission, and intelligent processing, and eventually to enhance the ability of integrated perception, decision-making and control in terms of monitoring and early warning of agro-products market price.

Key words: APIC; standards of information collection; classification and coding; GPS positioning; embedded technology

1. Introduction

In recent years, along with the intensified agri-market price volatility, especially fresh agricultural products, the pressure to secure effective supply and market stability of agro-products has been increasing, higher requirements for recognition, tracking, monitoring and regulating of the agri-price information have been put forward. However, the undeveloped information collection method, such as taking notes, filling in a table manually, reporting on line or by phone^[1] restricts

¹ Supported by Key Projects of National Key Technology R&D Program during the Twelfth Five-Year Plan Period (No. 2012BAH20B04)

Correspondence XU Shi-wei, Professor, Ph D, Tel:+86-10-82109902, E-mail: xushiwei@mail.caas.net.cn

real-time information collection. The incomplete and unclear information and non-uniform standards reduce the comparability of the agricultural products from different areas^[2]. Problems such as the undeveloped methods of agricultural information collection, nonstandard collection criteria, imperfect classification and coding and lack of information collection devices, call for the development and application of information collecting facilities in the agricultural sector^[3-6]. To deal with the complex reality, it's in urgent need to develop embedded, mobile and intelligent information collection devices^[7-9], to achieve the integration between on-field collection and information submission, and to identify market change signal quickly and make forecast and early warning timely.

This paper took advantage of the embedded technology and component technology to tailor hardware and software, developed mobile terminal device "APIC" with human-computer interaction, and realized instantly agri-price collection, rapid submission and intelligent analysis by means of GPRS technology.

2. The system design

2.1 Overall Framework

Combining the General packet radio service (GPRS) and 3G network with the technologies of the positioning system(GPS), geographic information system (GIS) and embedded development, this study developed a Portable Agricultural Product Holographic Market Information Terminal (APIC). In terms of mobile terminal to collect data, APIC is a basic component of the monitoring and early-warning system for agri-market price which is constituted of mobile terminal, database server and system platform. The structural diagram of the system is presented in Fig.1. Because APIC involves two industry standards, data collection has fulfilled standardization and normalization. Once market volatility occurs, the system center will release collection instruction and launch emergency collection program to get instant and targeted market information.

In order to achieve automatic storage, intelligent analysis and processing of agri-prices data by means of APIC, SQL Server 2008 enterprise edition was selected as database server operating system, and meanwhile Windows server 2008 64bit standard edition was chosen as database, through which the analyzed data would be sent to the system platform of early-warning center. Users will be able to query the latest and most timely agri-price information via Internet. In the meantime, system center platform can also push collection order and product information to the mobile terminal, to realize remote interaction management.

module takes advantage of the GPS for positioning information, GPRS, WiFi and BluetoothV2.0 as the input/output interface tool, providing users with various selection in the light of actual conditions. As for the human-computer interaction module, the screen adopts the latest version of 3.5 inch QVGA TFT screen developed by the international LCD screen expert-Casio, which uses the newly BlanView technology to improve visualization under the sun. Furthermore, APIC has built-in 3 million pixel camera, which can realize automatic focusing and collect on-field image data, to realize the visualization of data collection.

APIC is delicately designed, the size of which is 140 mm×77 mm ×23 mm (long ×width ×thickness), with the weight accumulated only to 191 grams. It also has strong environment adaptability, with technical grade characteristics of dustproof, waterproof, shockproof. The operating temperature range is from -20 °C to 60 °C; storage temperature can reach -30 °C to 70 °C; seismic can realize 1.0 m natural falling to the ground without damage; and its waterproof and dustproof character has achieved IP65 standard.

2.3 Software structure

The software architecture of APIC uses embedded design, the application software of which is conducted on the Windows Mobile operating system. The system is composed of 3 layers: operating system layer, service procedure layer and application layer. The software structure of the system is shown in Fig.3.

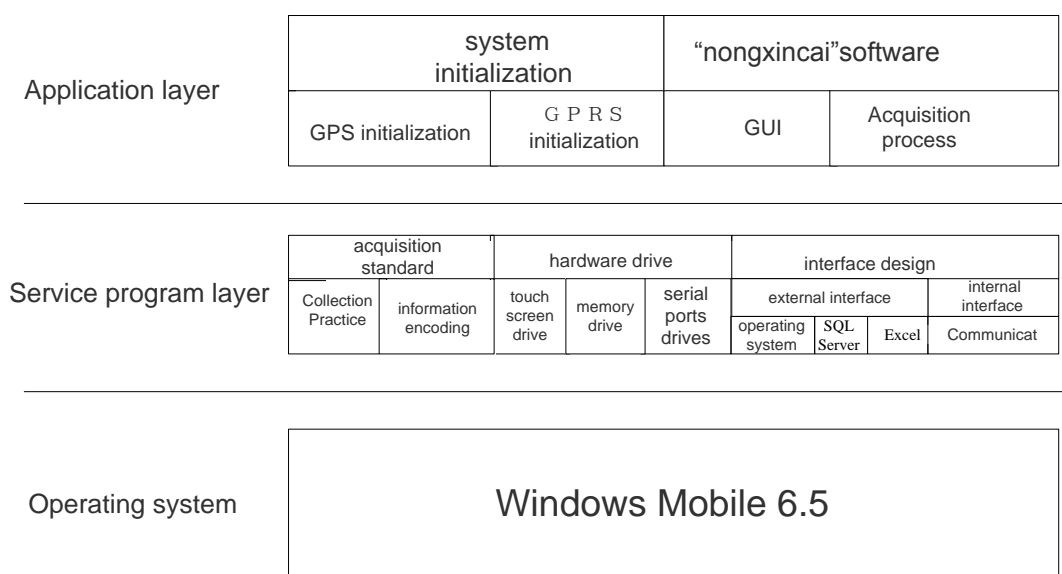


Fig.3 APIC Software structure

2.3.1 Operating system layer

The operating system of APIC is Microsoft Windows Mobile 6.5, and the CPU basic frequency reaches up to 600 MHZ, It can meet the requirements of map processing and large data computation. The multithreading, multitasking, complete pre-emptive operating system environment and the design of open mode structure make the software possess high compatibility. Even under small memory condition, it can also provide support for embedded mobile products. Improved power management system can prolong the service life of mobile devices. Standardized communication support system has made wireless communication come true through Internet.

2.3.2 Service program layer

(1) embedded in two industry standards on agri-information collection

APIC has been embedded in two industry standards: "Agricultural holographic market information collection standard NY/T2138-2012" and "The agricultural market information classification and computer code NY/T2137-2012" [10-12]. Integrating agricultural economic theory with modern information technology, APIC has established agricultural information collection coordination and mutual matching standard system, and has laid the foundation for data fusion and intelligent processing.

"Agricultural holographic market information collection standard NY/T2138-2012" has demonstrated major agricultural holographic market information elements, which mainly includes 11 aspects: trading hour, trading place, product name, authentication type, product grade, product origin, listing date, product price, trading volume, supply and measurement unit.

Table 1: agricultural holographic market information collection norms

Number	Content	Element	Description
1	trading hour	required options	The time of agricultural product transaction
2	trading places	required options	The place or the market where agricultural product transaction taken place
3	product name	required options	The name of agricultural product
4	authentication type	required options	The authentication type of agricultural product
5	product grades	selective options	The grade of agricultural product's quality specifications
6	product origin	selective options	The origin or source of the product
7	Listing date	selective options	The date from the production cycle entering into the circulation cycle
8	product prices	required options	The price of transaction, the unit is yuan/ measurement unit
9	trading volume	required options	The transaction volume of agricultural product
10	supply	selective options	The supply of agricultural product
11	measurement unit	required options	The unit of agricultural product

"The agricultural market information classification and computer code standard NY/T 2137-2012" listed the classification and coding directory of agricultural products in 11 major categories and 953 specific varieties. The 11 major categories agricultural products includes grain, oil, sugar, vegetable, fruit, meat, eggs, milk products, aquatic products, cotton and other agricultural products. Aiming at reducing the time of searching specific variety for information collectors, in terms of varieties classification, this study adopted six classification levels which include Large Class, the class, small classes, subclass, category, and commodity.

Table 2: agricultural products market information classification and computer code

Identifiers	Element	Format	Explanation
1	Trading hour	N12	YYYYMMDDHHMM
2	Trading places	N6+N4	6 districts and counties code(according to GB/T 2260)+1market-type+3market code(according to industry rules)
3	Product name	N13	According to NY/T 2137
4	Authentication	N1	Authentication type of products(1-common 、 2-pollution-free、 3-green、 4- organic)
5	Product grades	N1	Product quality level (1-first level,2-second level,3-third level)
6	Product origin	N6+N4	6 districts and counties code(according to GB/T 2260)+4Country code(according to GB/T 2260),when it shows the origin, the last 4number is 9+(3 market code),when the origin is enterprise, the last 4number is8+(3 enterprise code); Imported product code is 999+3country code(according to GB/T 2659)+4local code、 market code or enterprise code
7	Listing date	N8	YYYYMMDD
8	Product price	N4+N1	Unite: yuan/units of measurement; in the scientific notation, the first 4 number is significant figure(Including two decimal point),the last one is With the index of 10 at the bottom.
9	Trading volume	N4+N2	in the scientific notation, the first 4 number is significant figure(Including two decimal point),the last two are with the index of 10 at the bottom.Besides, the first means positive or negative(1-positive,2-negative),the last one means numerical value.
10	Supply	N4+N2	in the scientific notation, the first 4 number is significant figure(Including two decimal point),the last two are with the index of 10 at the bottom. Besides, the first means positive or negative(1-positive,2-negative),the last one means numerical value.
11	Measurement unit	N2	Gram(01)、 jin(02)、 kilogram (03)、 tone (04) 、 quantity measurement unit is number(21)、 head(22),etc.
12	check code	N2	According to GB/T 17710

The holographic market information encoding of each agricultural product is made of 12 layers 76 codes, and has established the encoding rules for APIC.

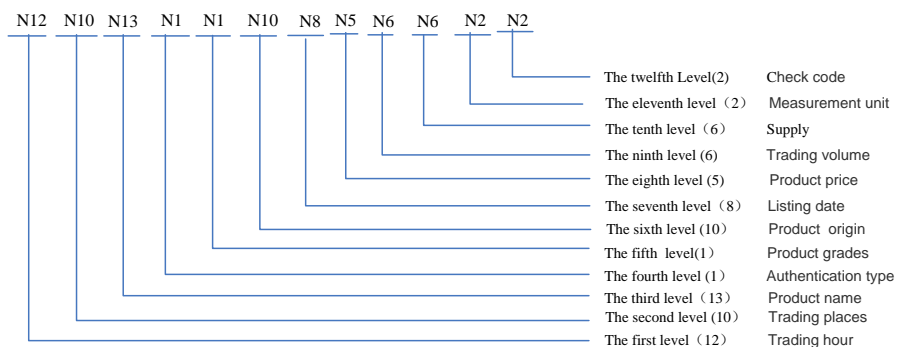


Fig.4 Code structure of agricultural information

(2) Hardware drives design and interface design

This module mainly includes touch screen driver, memory driver, serial ports drivers, etc. to protect software running. Interface design can be divided into two parts: internal interface and external interface. Internal interface is responsible for the communication between APIC and server center system, and external interface involves Windows operating system interface, SQL Server interface and Excel interface. By virtue of API function, SQL statement, JavaScript languages and the Object Linking and Embedding (OLE) technology, three interfaces including Windows operating system interface, SQL Server interface and Excel interface are realized.

2.3.3 Application layer

Application layer includes two parts: system initialization program and APIC price information collection software. System initialization program mainly involves GPS position and GPRS program initialization. With professional GPS engine and high sensitivity GPS antenna (MMCX straight interface), GPS module uses NMEA0183 data protocol to position accurately in real time (2-5 m (2 DRMS) SBAS: 1-3 m (2 DRMS)). Making use of GPS automatic match address of information collection, APIC decreases the steps of inputting information collection market and strengthening the idea of local collection. Its collection software is developed and realized its function by using C # language in Visual Studio 2008 development environment based on Windows Mobile technology.

3. Function and implementation of APIC

3.1 System function

The system of APIC contains five major function modules: System management, Data collection, Image collection, History enquiry and Knowledge database.

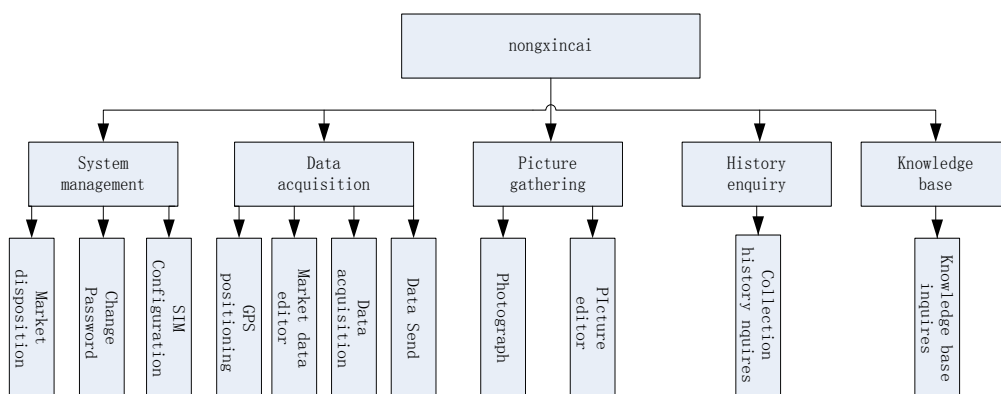


Fig.5 APIC function framework

System management is the foundation of the information collection. Before collecting data, the system firstly need to make five-step management configurations, including collection configuration, new market addition, password setting, SIM card configuration and positioning configuration. Collection configuration allows to adding or deleting markets or products. New market addition requires the latitude and longitude of data destination, then enter the information such as market name, market short name, market address, area coverage, market type, producing and sale locations. By virtue of entering old password, setting and confirming new password, it could enhance data encryption and improve data security. Setting SIM card number and device codes helps to ensure the matching of data transmission. The terminal possesses automatic update feature, which can automatically download and update in order to facilitate remote management.

Data collection is the core module of the APIC. When collecting data, according to the current latitude and longitude, the terminal will send a request to the servers, inquire and display the market information within one kilometer. Then the user can choose the target market and make data collection. If there is no market information about the current latitude and longitude, the system will jump into market adding page, add new market information, and then save it to the servers. Since data collection is completed, the follow step is to transmit data. If it is the first time for the user to submit data, the system will prompt the user to authenticate. After logging successfully, the data will be sent to the servers, and if failed, the data will be sent by GSM modem.

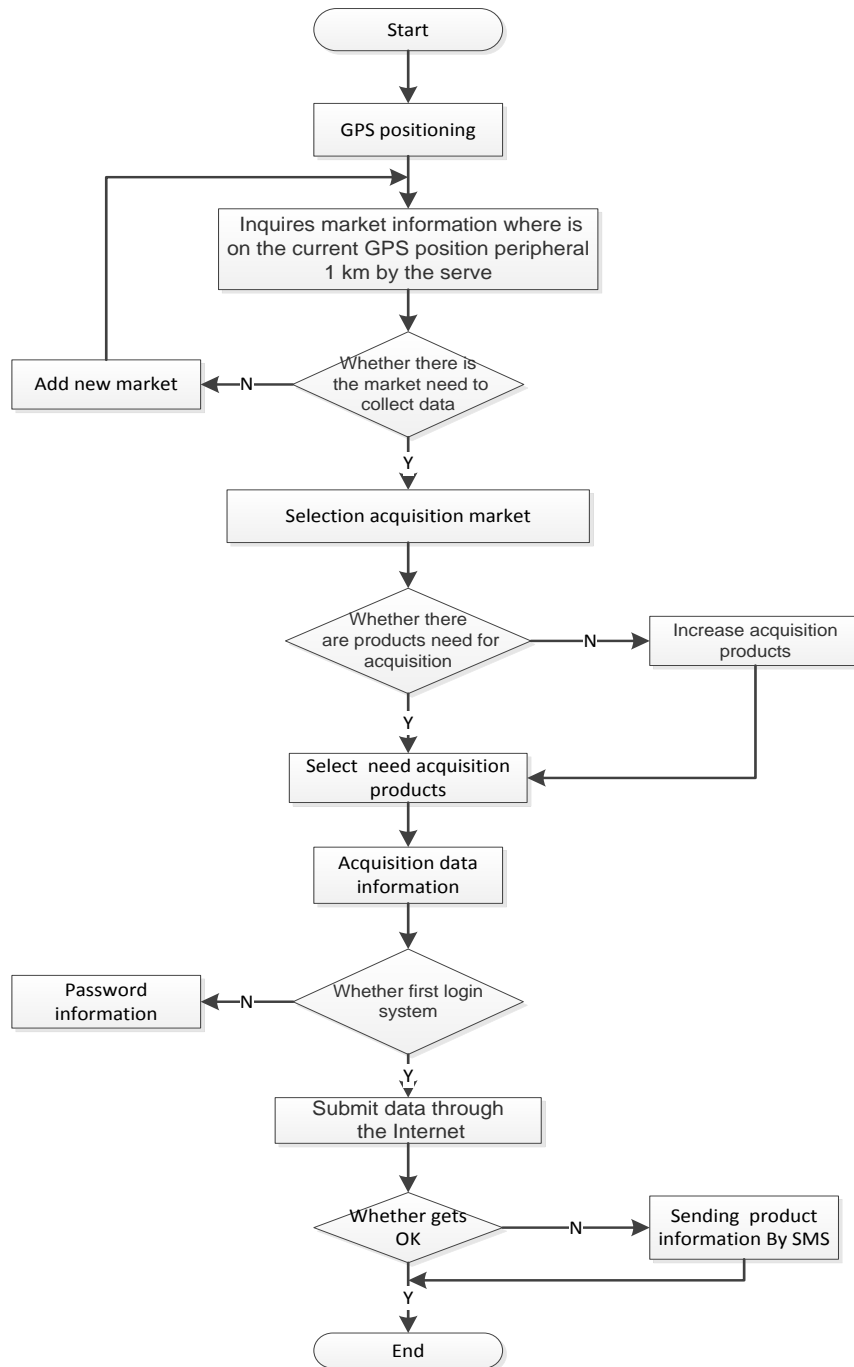


Fig.6 The data submitted process of the APIC

Moreover, the APIC can make use of the Image collection module to collect and manage images. History enquiry and Knowledge Base modules also contribute to the market information collection of agricultural products.

3.2 System implementation and application

APIC follows the graphical user interface (GUI) design principle, possessing the features like convenient interface, particularly striking function and fast response of system.



Fig.7 Function Interface of APIC

APIC has made field testing aiming at 65 varieties of agricultural products in 50 markets which distributed in five provinces including Hebei, Tianjin, Guangdong, Hunan and Fujian. Through the provincial testing, it has tested the functionality, stability, convenience and compatibility of the system among different regions, different varieties and different network environments. The present feedback has commendably represented the functionality and stability of this system.

4. Conclusions

The portable holographic agri-market information collection system has integrated mobile technology application with agricultural economic theory, taking advantage of the new 3S technologies. The development of APIC has abandoned the traditional “taking dictation” method, has provided significant opportunity to gather on-site data and transmit immediately, and has overcome the shortcomings of traditional ways, i.e. high cost, heavy tasks, low efficiency, poor security and statistic difficulties, etc. The device has provided fundamental support for data collection and subsequently intelligent analysis and early warning via fast response and continuous work. This study has changed the situation that in the past we could not get access to the data, hardly find the underlying reasons, and uneasy to propose suggestions on agri-price fluctuations. Through this system, users could trace the source of agricultural products, identify sale locations and investigate the responsibility. In addition, it has realized that “Detailed information of agricultural products circulating in the market could be submitted to the superior; authoritative voice could be released to outside, and effective actions could be taken to the subordinate”. The portable holographic agri-market information collection terminal will become an important tool in dynamic early-warning of agricultural products and process management.

References

- [1] Long Taihai. Design and Implementation of the portable intelligent terminal system. Shenyang Ligong University.2009.
- [2]Wang Zhe,Yin You,Zhang Shi—ming. Design and Realization of the Hand—hold Terminal Based on GLS / GPRS / GPS Remote Monitoring System. Journal of Lanzhou Jiaotong University, June 2009, Vol.28 No.3.

- [3]LiuHuali,WANGTao, XUWen. Study on application of portable data collection and bar code technology for management of panel warehouse. China Wood-Based Panels, 2005,12(2).
- [4]LIU Ping-zeng, BI Shu-sheng, LIANG Yong, XUE Xin-yu, XU Cheng-zhi. Design and implementation of Intelligent Terminal for Livestock Breeding Environment. Computer Engineering, October 2009,vol.35,No.19.
- [5]Zhang shirui, zheng wengang,etal. Agricultural products price information collection terminal of embedded protable wireless.Computer engineering and design.Feb,2002,Vol.33,No.2.
- [6]Wang lin, Shang zhou, Wang xuewei. The development and application of the data acquisition system.Electrical measurement & instrumentation.Aug,2004,Vol41,No.464.
- [7]Sun Jian, Li Dong, Zhang Lei-sheng, Li Chuan-wei. The Application of Wireless Network and Mobile Intelligent Terminal in Operation Examination. microcomputer information,Journal of information , 2005,24(3).
- [8]Hu shun-an,Wang shu mao. The intelligent system of Wireless Signal Sampling for Agriculture. MACHINERY,2005(6),32.
- [9]Xushiwei, zhangyongen, etal. Research on Standard and Classification Coding System of Holographic Information of Agricultural Products Market, Food and Nutrition in China, 2011, 17(12).
- [10]Standards of agri-product holographic-market –information collection NY/T2138-2012. China Agriculture Pressc.2012.02.21.
- [11]Classification and computer coding of agri-product market information NY/T2137-2012. China Agriculture Press. 2012.02.21.
- [12]Andrew W. Shepherd, Market information services–Theory and Practice. FAO agricultural services bulletin, 125, 1997.
- [13]Department of Economic and Social Affairs, Statistics Division. Detailed structure and correspondences of CPC (Ver.2) subclasses to ISIC (Rev.4) and HS. 2007.
- [14] World Customs Organization (WCO). The Harmonization Code System (HS-Code),2007.