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# Research on Orchard Field Data Service System

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**Abstract.** The precise management of orchards cannot do without the support of various orchard field data, and the orchard field data server is an effective solution thereto. The orchard field data server consists of data acquisition unit, data communication unit, data analysis unit and such diversified server sockets of user terminal as supportive personal computer (PC), notebook computer, mobile phone and telephone. The orchard workers can set data acquisition cycle according to the requirements, and the processed data can serve the orchard workers in many respects. After its promotion and application in many orchards in such regions as Liaoning and Beijing, the said system has been proved to be of easy use and reliable effect, so that the project has achieved good social, ecological and economic benefits.

**Keywords:** orchard; field data service; diversified terminals; service for orchard workers; precise management

## 1. Introduction

China's fruit output ranks No. 1 in the world [1], but its output value is low. The main reason is the low level of production and business operation, which has caused the poor quality of fruits [2, 3]. Consequently, it is difficult for us to compete with such countries as the United States, Italy and Japan in the international market. To improve the level of our fruits, we must enhance the level of business operation. It is the international practice to improve and transform the traditional fruit industry by means of standardization and informatization [4] in the industrial production. The basis of the standardization and informatization is the precise control of the basic data in production and management. Orchard is the basic area division in fruit industrial production and the basic organization of production and business operation. Therefore, to acquire, sort out, process and analyze the data in the orchard as a unit, and to use them in serving the orchard before production, during production and after production would constitute the aim of this research. The purpose of the orchard field data server is to acquire the orchard field meteorology and field video. After the data are sent back to the network server, the authorized orchard workers

and/or other users are able to refer, in real time, to the orchard field data. After these field data are processed by means of the professional software, they can be used to provide service and guidance for the orchard workers in respect of the production and business operation.

## 2. System Design

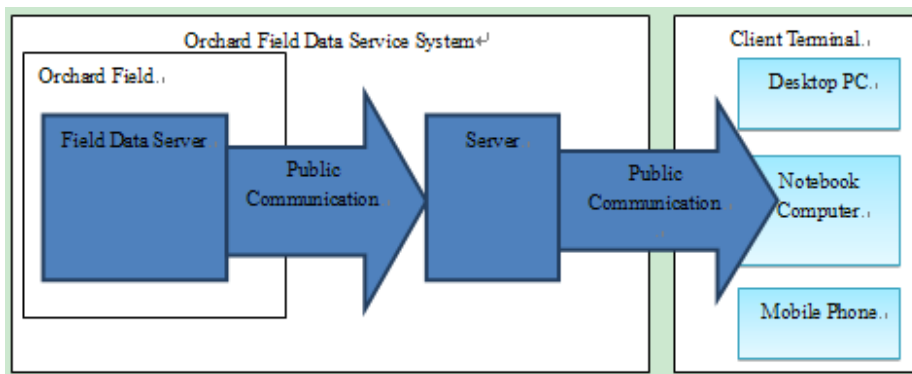
### 2.1 Aim of the System

Orchard is the basic unit in the production and business operation of fruit industry. So it is in the orchard as a unit that the orchard field data acquisition system designed to provide service for the production and business operation would serve the orchard workers before production, during production and after production. The purpose of this product is designed to improve the orchard workers' level of production and business operation and to strengthen the competitiveness of the products.

### 1.2 Framework of the System

The system consists of field data acquisition unit, data transmission unit, data processing unit and service unit.

The field data acquisition unit is used to acquire the orchard meteorology and video data, and the data transmission unit is designed to transmit them into the server through the communication network. After the data are processed and analyzed on the server, they are used to provide service for the orchard workers and/or other clients.



**Figure 1.** System Frame Diagram of Orchard Field Data Acquisition Server

The field data server consists of such four parts as meteorological data acquisition unit, video image data acquisition unit, data transmission platform and power supply

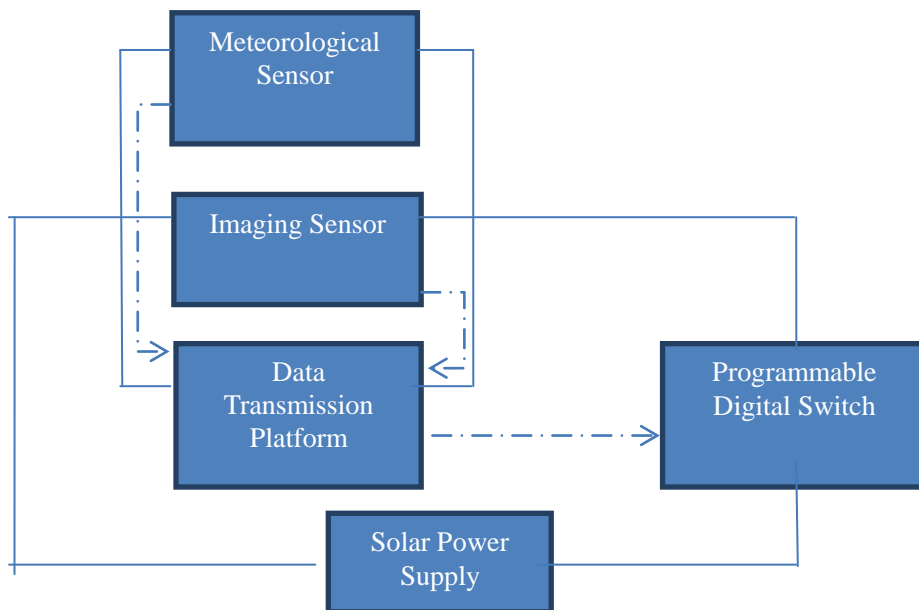
unit. Each of these acquisition units is assembled by such modules as are in conformity with the industrial standards.

The meteorological data acquisition unit can be connected with 20 digital meteorological sensors, which would mainly include such sensors as for air temperature and humidity, soil temperature and humidity, photo-synthetically active radiation and carbon dioxide concentration, but could be increased or decreased according to the actual needs.

The video image acquisition unit is composed by a group of video cameras, including cable video cameras and wireless video cameras.

The data transmission platform is of such functions as video compression and format conversion, voice transmission and data transmission. Two R232 interfaces, two R485 interfaces, one voice input-output interface and one video input interface are used to respectively accomplish the transmission of data, voice and video. Their connections are shown in Figure 2.

The device adopts solar power supply, including solar-cell panel, storage battery and programmable digital switch. The programmable power supply timer is connected with the data transmission platform to receive control instructions.



**Figure 2.** Connection Diagram of Field Data Server

In Figure 2, the solid line indicates the circuit diagram, but the dotted line indicates the signal transmission diagram.

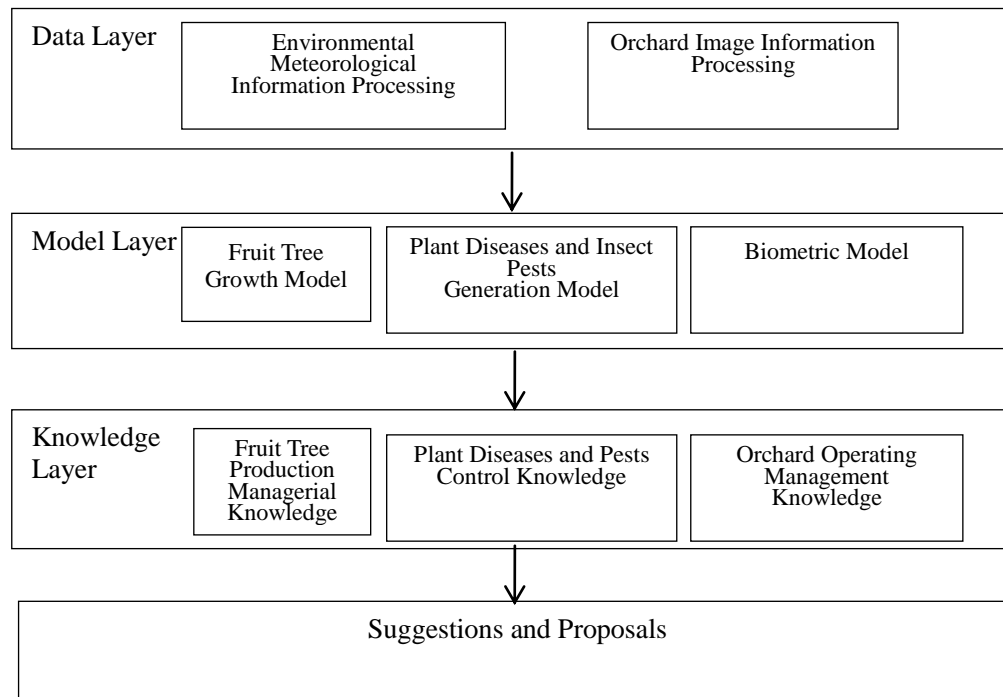
The data transmission platform is the core of the orchard field data server, including four video channels, one audio channel, two R232 channels and two R485 channels, and also including the built-in audio and video compression and format conversion functions, GPRS and WCDMA communication modules, and GPS positioning module.

The meteorological data acquisition unit and video image acquisition unit are used to transmit the signal to the data transmission unit. After various built-in processing, the signal is sent to the public network through the GPRS or WCDMA module. In the built-in communication module, there is a communication signal strength monitoring module, which would automatically use the GPRS module for transmission if the 3G signal becomes very weak.

After the data are transmitted back to the server, they are to be stored in the database. It is not necessary to give more details in respect to the design of the database.

### 2.3 Framework of the System Functions

The application of the system can be designed and developed according to the requirements of the clients. Its core functions are designed to cover the meteorological data service and video image service, but a lot of extended applications can be developed according to the requirements of the clients. The frame diagram of the systemic functions is shown in Figure 3.



**Figure 3.** Schematic Diagram of Systemic Functions

### 3. Application Cases

It is with the support of the MOST's State High-tech Program (863) and the Program of Commercialization of Agricultural Research Findings that this system has been gradually developed and matured. In recent years, this system has been applied to many aspects, which has achieved very good social and economic benefits. In the following, the "Hot Line of Orchard Workers" is taken as the case of application to analyze and demonstrate the application and functions of the orchard field data service system.

The "Hot Line of Orchard Workers (<http://www.cart.net.cn/>)" is an agricultural information service platform in the comprehensive network jointly developed by the Institute of Agricultural Information and the Institute of Pomology of the Chinese Academy of Agricultural Sciences. By use of the "four-in-one" approach of website, telephone, mobile phone and TV, the "Hot Line of Orchard Workers" is designed to provide all-sided and public beneficial agricultural information service for the orchard workers throughout the country, which is related to the latest information on fruit trees and nursery stock, market price quotations, practical cultivation technique, fruiter disease control technique, and so forth. It is the good helper and friend for the orchard workers to acquire wealth.

The system has been developed on the basis of the orchard field data service system. And the system application has been extended and developed on the basis of the functions of the orchard field data service system. The system interface of the "Hot Line of Orchard Workers" is shown in Figure 4.

The system functions include home page, nursery stock recommendations, online consultation, technical service, production and marketing service, market information, expert system and training classroom on-line.

The system data are supported by 20 orchard field data servers, which are located in 20 orchards in China's Liaoning Province and Beijing. The orchard field meteorological data are acquired once every 20 minutes, and the image data are collected once every four hours. If necessary, it is possible to make recording of the video or real-time monitoring of the orchard field. Figure 5 is the schematic diagram of the orchard field data server, which is located in a certain orchard located in Shunyi District of Beijing.



Figure 4. Interface of “Hot Line of Orchard Workers”



Figure 5. Orchard Field Data Server

#### 4. Discussion

The orchard field data server is a set of intelligent maintenance-free system, which is all integrated by such modules as are of independent functions. It is so safe and easy to use with stable performance that it has achieved satisfactory results after trial use in some provinces and cities in northern China. It is particularly suitable for the orchard data acquisition service in such districts that are unattended and/or inconvenient in power supply.

At present, the existing problems are focused on the following aspects:

The first is the determination of the battery capacity. In northern China where most of the days are sunny, this system can satisfy the use in most regions, since it can supply power for 20 consecutive hours, in which it can satisfy the power utilization of the system for one week if the system works two hours per day. On such special



occasions as necessary to make consecutive video monitoring, consideration may be made to use the electric supply. But in southern China, in some extreme weathers in the rainy season, it may be difficult to satisfy the power supply. In such cases, it is recommended to change even higher capacity of storage batteries and even larger size of solar panels.

The second is the acquisition of video images. In the system's automatic video recording, it may be influenced by the light intensity. In such cases, consideration should be made to add a light intensity detecting unit to the system to automatically adjust the lens angle, so as to ensure the quality of the video and images.

## 5. Acknowledgments

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