

## A Design of Ginseng Planting Environment Monitoring System Based on WSN

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**Abstract:** Through the analysis of ginseng products industry chain, this paper designs and implements ginseng planting environment monitoring system. The system realized data collection and detection of ginseng planting environment in real time by using wireless sensor, transmission of environmental parameters in real time by using GPRS wireless transmission module, and video monitor and alarm of ginseng land by using unattended machine. It is the foundation of information transformation of ginseng products industry chain based on the Internet of Things. The experiment of ginseng planting base in Fusong indicates the system can offer support of original data for scientific cultivation of ginseng, comprehensive analysis of ginseng products and propaganda of ginseng brand. Copyright © 2014 IFSA Publishing, S. L.

**Keywords:** Internet of Things, Precision agriculture, Information traceability, Data collection, Video monitor.

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### 1. Introduction

At present, Internet of Things is at a stage of comprehensive development. Internet of things is applied in many fields, such as environment monitoring, traffic control, disaster emergency, precision agriculture, and has got certain achievements [1-4]. Applying Internet of Things to modern agriculture can reduce labor consumption, effect manual operation to crops, collect accurate environmental information of crops. It implements scientific managing, scientific planting and agriculture with intelligence, information and automation.

China is the largest country in the production of ginseng [6]. In order to solve problems in ginseng industry development, it is necessary to transform traditional ginseng industry in management models of modern chain and development models of characteristic industry [7-8]. In the process of

transforming researching and developing information traceability platform of ginseng products industry chain (GPIC-ITP) is necessary. It implements the uniform management in production of ginseng products which includes seed selection, breeding, planting, transplantation, recovery, process, packaging and so on. Meanwhile, it can enhance the quality of ginsengs and the credibility of ginseng products, and then offer scientific basis for propaganda of ginseng products and information services for consumers who purchase ginseng products. As perception layer, ginseng planting environment monitoring system is the foundation and core in this platform. Above all, this paper designed and achieved the real-time collect, transmit and feedback of the information in ginseng planting environment, and provide reliable, true and original data support for scientific planting and function developing of ginseng, comprehensive analysis of ginseng industry, and ginseng brand propaganda

through monitoring the ginseng planting environment, gathering temperature, humidity and illumination etc.

## 2. Requirements Analysis

Information traceability platform of ginseng products industrial chain processes informationized transformation on production of ginseng products with Internet of Things application technology. End-users can access to the platform through RFID, two-dimension code and Web to retrace related information of the certain ginseng products. Firstly, the platform detects the soil, which can form detection report, and then number ginseng lands according to GPS coordinate of each land; secondly, type-in the information of seed selection and breeding of ginsengs, and deploy wireless sensors, which are numbered according to the number of land that it belongs to; thirdly, pick and pack ginsengs, play yards; fourthly, transport and process ginsengs. We should divide process areas according to ginseng lands when unboxing ginsengs. Fig. 1 depicts workflow of the GPIC-ITP.

The information transformation includes monitoring of ginseng planting environment, transformation and monitoring of production line of ginseng products and construction of information traceability platform. The system designed in this paper collects information of ginsengs planting environment by deploying wireless sensors and implementing monitoring information of ginseng planting environment in real time. The information includes places of origin of ginsengs, variety of ginsengs, usage of pesticide, control of insect, edatope and so on. The construction of Ginseng Planting Environment Monitoring System is shown in Fig. 2.

## 3. Implement Scheme

The implement scheme of ginseng planting environment monitoring system includes data collection and transmission subsystem and unattended video monitoring subsystem.

### 3.1. Data Collection and Transmission Subsystem

Wireless sensors are deployed to ginseng lands to collect temperature, humidity, illumination and air pressure on the surface and soil temperature, soil moisture and soil PH underground when implementing the data collection and transmission subsystem. This subsystem implements data transmission with Zig-bee ad hoc network technology and GPRS wireless communication technology. This subsystem concludes Information Probing Unit and

Data Transmission Unit. The structure chart of the subsystem is shown in Fig. 3.

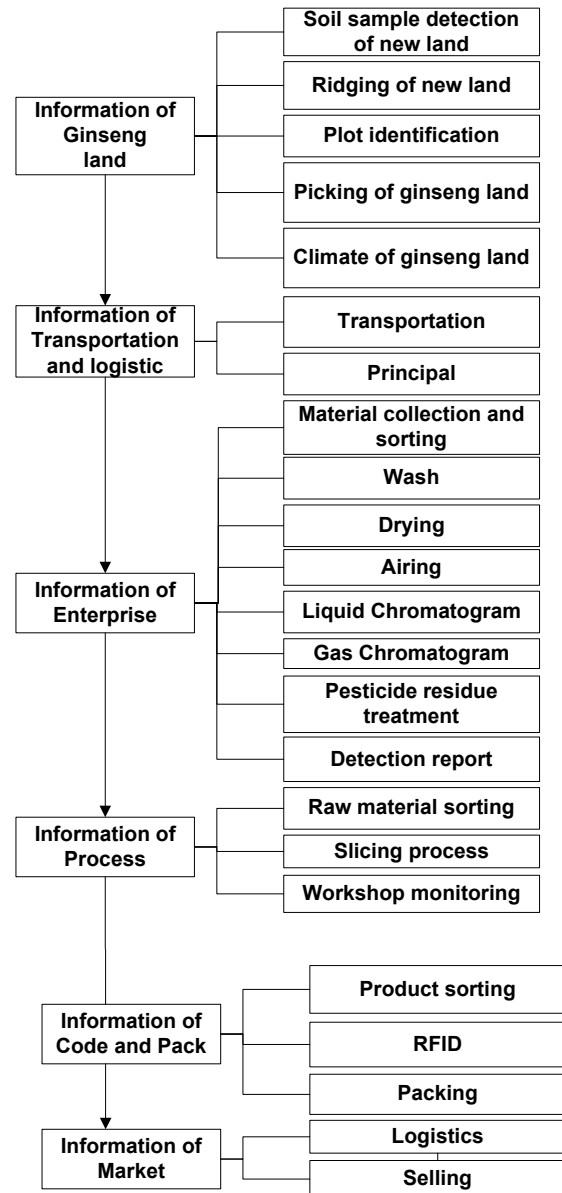


Fig. 1. Workflow of the GPIC-ITP.

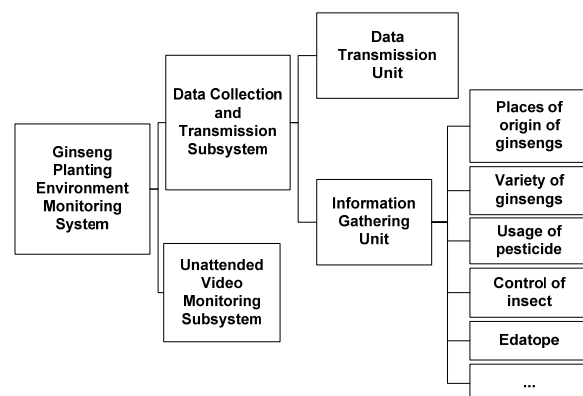


Fig. 2. The construction of ginseng planting environment monitoring system.

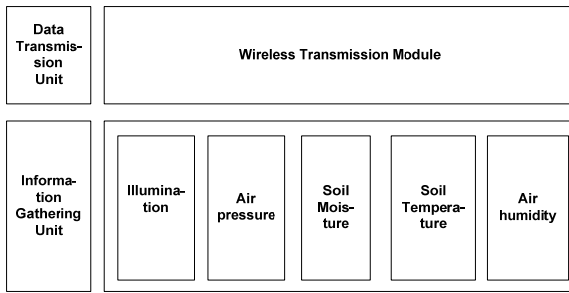


Fig. 3. Structure chart of data collection and transmission subsystem.

• Information Gathering Unit.

Information gathering units collect real-time information of ginseng planting environment in every 10 seconds. Hardware devices as shown in Table 1 conclude air temperature sensor, air humidity sensor, soil moisture sensor, soil temperature sensor and illumination sensor.

Table 1. Parameters of Hardware Devices.

Name	Parameter	Value
Soil Sensor	Measurement range of temperature	-20 °C ~ 70 °C
	Measurement accuracy of temperature	± 0.5 °C
	Measurement range of soil moisture	dry soil ~ water saturated soil
	Measurement accuracy of soil moisture	± 2.5 %
	Measurement range of soil alinity	0~17 dS/m
	Measurement accuracy of soil salinity	dry soil±4%, water saturated soil ±10 %
	Communication mode	GPRS and Server
The field micro-climate weather station	Measurement range of atmospheric pressure	880~1080 hPa
	Resolution of atmospheric pressure	0.1 hPa
	Measurement accuracy of atmospheric pressure	1 hPa
	Measurement range of relative humidity	10~90 %
	Resolution of relative humidity	1 %
	Measurement accuracy of relative humidity	3 %
	Measurement range of outside temperature	-40~65°C
	Resolution of outside temperature	0.1°C
	Measurement range of rainfall	0~9999 mm
	Resolution of rainfall	0.2 mm
	Measurement accuracy of rainfall	4 %
	Measurement range of wind speed	1~67 m/s
	Resolution of wind speed	0.1 m/s
	Measurement accuracy of wind speed	5 %
	Measurement range of wind direction	0~360°
	Resolution of wind direction	1°
	Measurement accuracy of wind direction	7°
	Communication mode	soil sensor: serial communication server: GPRS
	Charge mode of battery	alternating current input voltage: 220 VAC output voltage: 5 VDC~9 VDC charge current: 2 A

• Data Transmission Unit.

Data transmission unit transmits environment parameters to host computer and then save them to data warehouse by accessing wireless sensors to Internet and using wireless transmission modules with GPRS. The relationship among wireless sensor network about ginseng planting environment, mobile network and data center is shown in Fig. 4. Sensor nodes are the elementary unit of wireless transmission network. They can be scattered in the area which is monitored area and make up network in a way of self-organization. Host computer manages these sensor nodes and synthetically process the collected data to get the needed information.

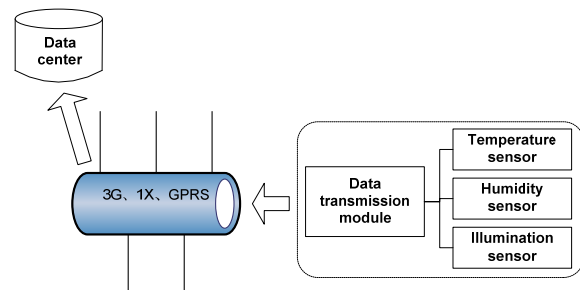


Fig. 4. Relationship among Wireless Sensor Network about Ginseng Planting Environment, Mobile Network and Data Center.

Ginseng planting environment monitoring system supplies power with solar-cell panel and large capacity storage battery because ginseng lands are remote. The power module has heavy tasks, which provides required voltage for each part of system and protects system when it powers down. The system should provide standby power in order to ensure continuous data-collection and data-transmission after powered down. The solar-cell panel provides 12 VDC for the system and charges storage battery with a condition of rich illumination. However, the storage battery provides power for the system with a condition of low illumination. The system adopts lead-acid battery with 60 AH as a stand-by power. The construction of solar power system is shown in Fig. 5.

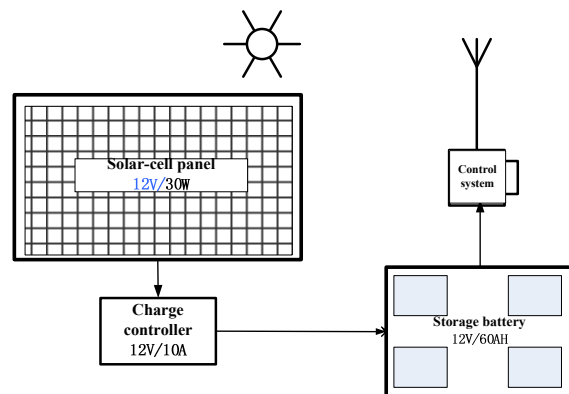


Fig. 5. The construction of solar power system.

### 3.2. Unattended Video Monitoring Subsystem

The traditional video monitoring system should not transmit a remote video signal but only perform video monitoring on scene and simple alarm because of the limitation of technology. Meanwhile, it is difficult to get the specific conditions and event confirmation of the scene, and then reduce the practicability, stability and security of the system intangibly. Moreover, the unattended video monitoring system designed in this paper integrates the 3rd generation telecommunication, transmission technology of TCP/IP, collection storage transmission of wireless high resolution digital image, remote network control technology, multi-detector intrusion alarm detection technology. It implements monitoring, alarm, record and playback of images on scene of remote target. The subsystem is convenient, portable and supports high-speed mobile. The position of network control points can be increased, decreased and updated as required, therefore it is reasonable to treat high-speed vehicles which are performing tasks of monitoring as mobile control points.

The subsystem which is shown in Fig. 6 consists of ARM core controller, monitoring and detecting system, image collection system, alarm system, wireless transmission system, infrared lighting system and power system. When monitoring the circumstance of ginseng lands, the subsystem informs the host computer of abnormal condition through 3G and its burglar alarm makes a shrill sound to alarm once targets enter into the monitoring area. Meanwhile it open the floodlight and shoot immediately in order to get images of the scene, The images should be stored and transmitted to the host computer. This subsystem implements automatic alarm on scene and the centralized control management of multi-alarm signal in different places. In the case of alarm, linkage camera of audio-video monitoring system positions to the scene instantly, and then records a video in real time in order to take the evidence after accident conveniently.

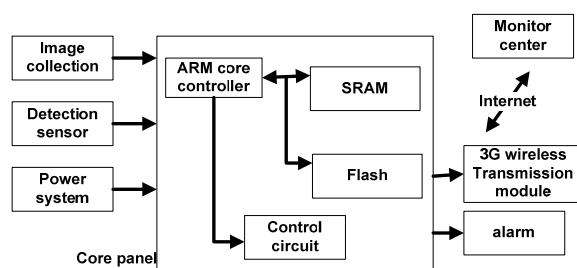


Fig. 6. The construction of unattended video monitoring subsystem.

### 4. Conclusions

This paper analyzes and designs ginseng planting environment monitoring system using the Internet of Things application technology and the technology of wireless sensor network. The authors design the implement scheme of the system in detail from data collection and transmission and unattended video monitor. The data collection and transmission parts give the construction of data collection system, the way of data transmission and power supply mode. The part of attended video monitor gives the construction and the work mode of the unattended machine. The system collects information of ginseng planting environment in real time and uploads to data warehouse. In monitoring process of monitoring, the system does not have artificial operation, which avoids disturbance of human factor and ensures the authenticity and availability of data. The system provides support of original data in improving quality of ginsengs, implementing scientific planting and advertising brand of ginseng products, and it also provides scientific evidence for comprehensive analysis of ginseng products.

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