



**HAL**  
open science

## Quinoa Traceable System Based on Internet of Things

Guowei Wang, Yu Sun, Jing Chen, Yang Jiao, Chuanhong Zhang, Haijiao Yu,  
Chan Lin, Guogang Zhao

► **To cite this version:**

Guowei Wang, Yu Sun, Jing Chen, Yang Jiao, Chuanhong Zhang, et al.. Quinoa Traceable System Based on Internet of Things. 11th International Conference on Computer and Computing Technologies in Agriculture (CCTA), Aug 2017, Jilin, China. pp.1-8, 10.1007/978-3-030-06137-1\_1. hal-02124219

**HAL Id: hal-02124219**

**<https://inria.hal.science/hal-02124219v1>**

Submitted on 9 May 2019

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

# Quinoa traceable system based on Internet of things

Guowei Wang<sup>1</sup>, Yu Sun<sup>1</sup>, Jing Chen<sup>1</sup>, Yang Jiao<sup>2</sup>, Chuanhong Zhang<sup>3(✉)</sup>, Haijiao Yu<sup>4</sup>, Chan Lin<sup>4</sup>, Guogang Zhao<sup>4</sup>

<sup>1</sup>College of Information Technology, Jilin Agricultural University, Changchun, 130118, China

41422306@qq.com, 398223842@qq.com, 1453647147@qq.com

<sup>2</sup>Sixth Middle School in Changchun, Changchun, 130000, China;  
61516131@qq.com

<sup>3</sup>Changchun Sci-tech University, Changchun, 130600, China;  
15844005115@163.com

<sup>4</sup>The City College of JLJU, Changchun, 130000, China;  
haihai951kl@163.com, 1666931636@qq.com, zhaogg2010@foxmail.com

**Abstract.** Quinoa is known as the lost ancient "gold" nutrition, along with the increase of domestic demand, in recent years at home also growing acreage, in order to solve the quinoa products traceability of quinoa planting, pesticides fertilizer use and processing data information acquisition, storage and processing, and other issues. This article USES the Internet of things technology, ZigBee development technology and space technology such as fuzzy data mining, based on the Internet of things of quinoa traceability system, realized the quinoa cultivation, production and transportation, warehousing and other real-time data acquisition, transmission, processing, and text messages warning and quinoa disease quinoa products full traceability, etc. This project research has completed a preliminary test in the experimental base, basic functions required to complete the project, can achieve the goal of the quinoa products traceability.

**Keywords:** IOT · Quinoa · Traceability system

## 1 Introduction

With the improvement of people's living standards, people have set higher demands on food. Quinoa is not only rich in nutrients of all kinds for human needs, but also possesses high-quality proteins close to the amino acid composition of human body. It is an important function to increase the nutritional value of food for the population food. In the meantime[1], the development of the quinoa industry can reduce the human demand for animal protein to a certain extent, thereby reducing the input of livestock, pens and human resources in the breeding industry, the occupation of cultivated land in the breeding grounds, and the pollution of animal excrement to the environment[2].

Based on this, this project designs and develops a set of traceability system of quinoa based on Internet of Things. The system core technology and equipment for independent development, the overall high level of technology, and complete sets of

equipment costs and prices much lower than similar foreign products, with the support of specialized software, the monitoring data can be quantified, scientific decision-making[3]. Provide a typical demonstration reference for the traditional agricultural production manual mode to the agricultural informationization, intelligent and large-scale production mode transformation.

### **1.1 The research status**

LIN Fengsheng and FU Xiang introduce through the analysis on the whole circulation process for imported food, a quality safety traceability system based on quality safety critical control point analysis was proposed[4] in 《Quality Traceability System for Imported Food Based on Critical Control Point Analysis》, FENG Chun-wei and GONG You-hui introduce a fruit and vegetable traceability system on the strength of the Internet of things (IoT) technology and the GPS and 3G/4G technology was designed[5] in 《Design on IoT-based Fruit and Vegetable Traceability System》.

## **2 Main research content**

Based on the Internet of Things technology, this project has perfected a set of traceability system for quality monitoring records analysis of quinoa planting, processing, transporting and warehousing processes. The project focuses more on the planting and processing of quinoa, collecting, transmitting and storing the data of the key processes such as quinoa planting and processing through the Internet of Things technology so that the products have a unique identification throughout the process and are added The early warning system to ensure the controllable operation of product quality. The main technologies of this project include the following aspects

### **2.1 planting process can be controlled**

In quinoa is adopting the data entry of planting stage, using the mature technology of Internet of things will quinoa grown stage of resource allocation and other important information into the database, the data in the process of planting and processing real-time monitoring, calculated by the system science, irrigation, fertilization and pesticide dosage, promoting the scientific and standardized planting quinoa production[6-7].

Use at present relatively mature and stable ZigBee transmission technology in the field of network communication, at the same time establish a wireless sensor network to complete the quinoa growth environment of soil temperature, soil humidity, illumination, temperature, air temperature, air humidity, and crop status and automatic data acquisition of agricultural information. Field workbench USES solar power systems provide energy, the use of GPRS network communication to transmit data through the network to the server, the server for data receiving, parsing, storage, forwarding, etc.

## **2.2 The whole process of data monitoring**

The traceability system supported by the database, using the unique identification code, by marking a design and labeled data interaction to complete the underlying structures of the traceability system. In logistics link to use automatic qr code identification record all data information, realize the traceability of the product, at the same time, using a large amount of data to support the warning system for the whole digital early warning information.

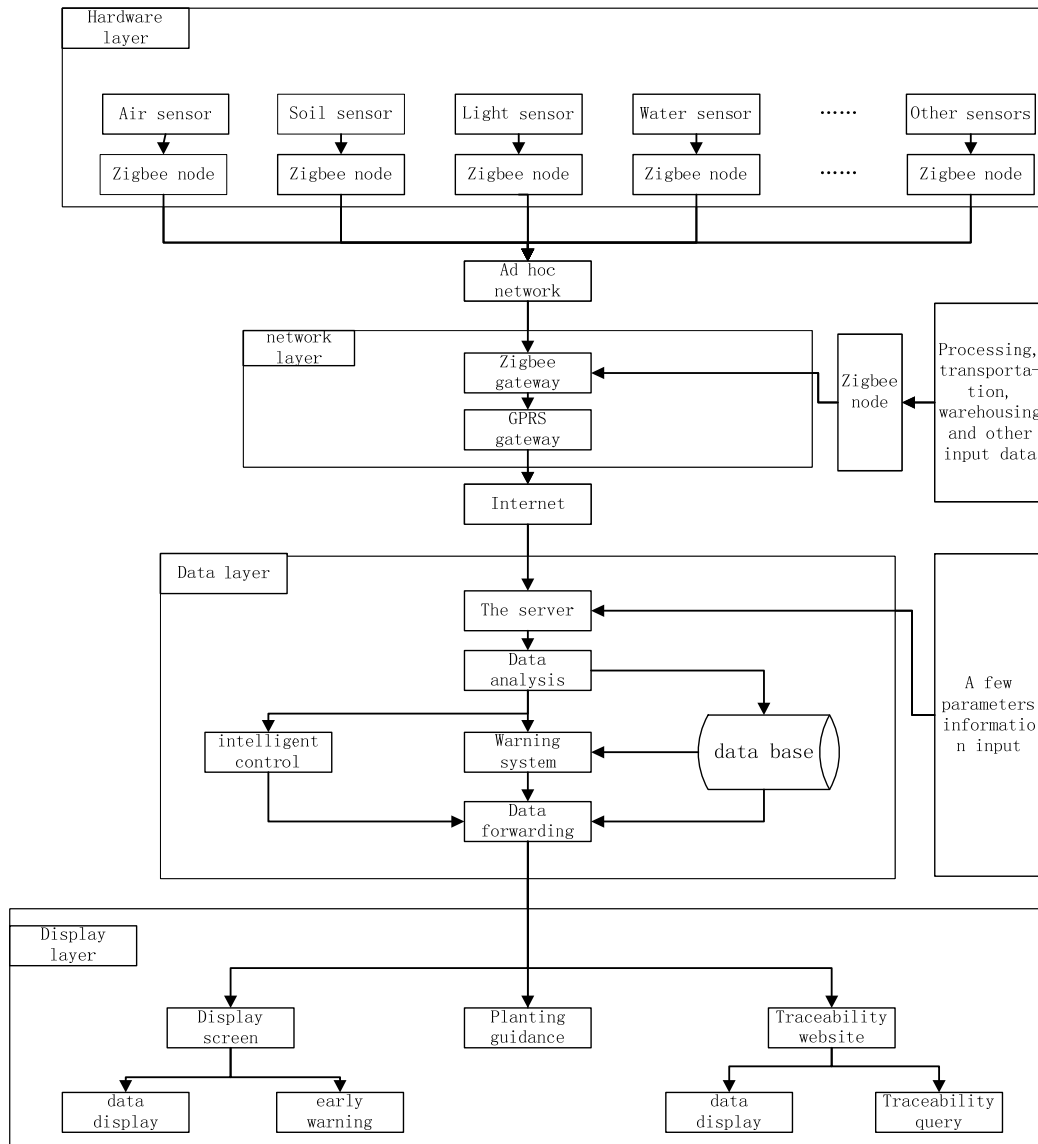
## **2.3 Key information traceability**

Establish a traceability website, use the database to organize the above information storage, through the product above the unique identification code can be queried on the network quinoa products in the planting, processing and transportation links and other important information, making quinoa food safety is not It is an empty talk..

## **3 Stem design**

The system mainly includes hardware layer, network layer, data layer and display layer, a total of five aspects. Among them, the hardware layer mainly includes various types of sensors during the quinoa growing stage and RFID and two-dimensional code scanning equipment installed on per processing equipment during the quinoa processing. The hardware layer is mainly responsible for all aspects of the basic data acquisition. The network layer mainly includes zigbee transmission network and GPRS transmission gateway, which is mainly responsible for transmitting the basic data stably and efficiently to the server. The data layer mainly includes quinoa traceability server and database, receives a large amount of basic data through the server, parses, organizes and analyzes and finally stores it into the database, supplemented by a small amount of manual data entry to provide complete data support for the entire traceability system . The display layer mainly includes the data display set up by the quinoa cultivation site and the quinoa traceability website. Data display real-time display of the basic data, but also for quinoa planting workers to provide real-time warning information. The Traceability Web site provides a stable and secure check-in point for end consumers who purchase quinoa products. Quercetin can be found on the website using the unique identification code on the quinoa bag to find out where the quinoa is grown, produced, and shipped Of the important information.

The overall design of the system as shown below:



**Fig.1**System main architecture diagram

### 3.1 Hardware layer

The main role of the hardware layer is responsible for the detection of quinoa planting and other related aspects of the data. It consists of soil sensors, air sensors, light sensors, water temperature sensors, several smart switches, several environmental monitoring cameras placed in quinoa fields and several processing monitoring

cameras placed in the processing sites, sensors for collecting other parameters, Sensor and data transmission port one by one corresponding to the Zigbee nodes together.

Some of these data acquisition ranges are shown in the following table

**Table 1.**Measurement data sheet

Measurement items	Measuring range	Measurement mode
air temperature	temperature 0-50°C	Continuous measurement
air humidity	humidity 0-100%	Continuous measurement
water temperature	temperature 0-60°C	Continuous measurement
illuminance	1-65532lux	Continuous measurement
soil temperature	temperature 0-50°C	Continuous measurement
soil moisture	humidity 0-100%	Continuous measurement
Environmental surveillance cameras	Quinoa field	Continuous measurement
Process monitoring cameras	Quinoa processing area	Continuous measurement

### 3.2 Network layer

The main function of the network layer is to collect the data collected by the hardware layer and send it to the server quickly and stably. Through Zigbee node self-organizing network will be carried by each node data aggregated to the Zigbee gateway, the Zigbee gateway will be aggregated data sent to the GPRS gateway. The format that the GPRS gateway converts the data into the byte array is sent to the server via the network

### 3.3 Data layer

The main function of the data layer is to receive, organize, analyze, store and forward data. Data layer by the server and database composed of two parts. After the server receives the data sent by the GPRS gateway, the server analyzes the data, analyzes it and stores it in the database. The main function of the database is to store all the data generated from all traceability systems and provide data support for early warning and intelligent control of traceability systems.

#### 3.3.1 The server

Server is mainly composed of two modules, respectively is data reception processing module and data sending module.

Data receiving and processing module of the main workflow: First, the server to open a dedicated Socket monitoring function, the establishment of a data transmission

between the TCP / IP data transmission connection. Then, the data observing node collects the data to its designated GPRS gateway through the wireless network, and finally sends the collected environment data to the specified IP address (ie, the IP address of the server)[8-9]. In order to achieve the function of sending data sent by the data sending gateway at any time. Finally, the accepted data is processed and stored in the database, and displayed on the server side. So as to achieve the remote monitoring of quinoa growing environment-related data results.

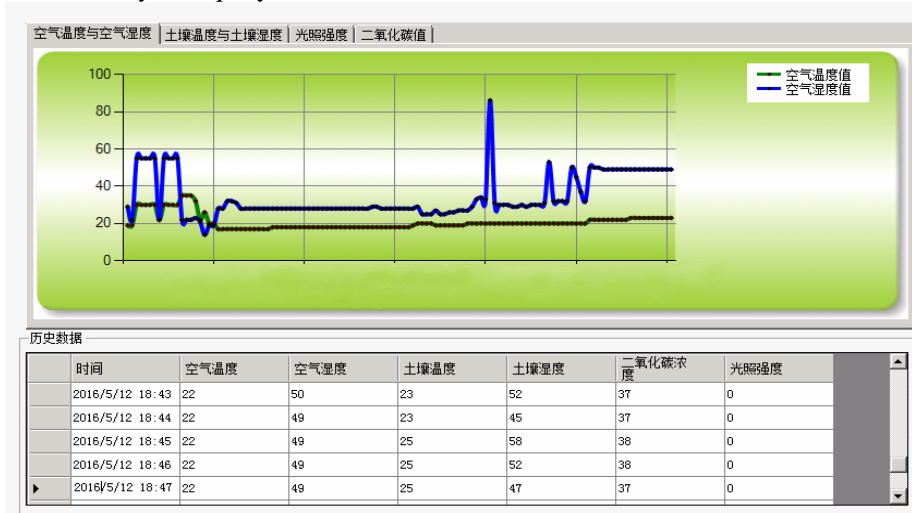
Some of these data processing rules are shown in the following table:

**Table 2.**Data analysis table

String format	Post recognition data
A20.0#32.0#0x00158d00:0x001c6615	The air temperature sent by the 0x00158d00:0x001c6615 node is 20 °C and the humidity is about 32%。
B18.6#0x00158d00:0x001c6615	The water temperature sent by 0x00158d00:0x001c6615 node is 20 °C 。
C23054.1#0x00158d00:0x001c6615	The light intensity sent by 0x00158d00:0x001c6615 node is 23054.1lx 。

Data sending module: in order to reach the timely detection of environmental data, data needs to be sent to the corresponding screen at the same time for technical personnel in time to see. So the server will also need a data interface, through the Socket and TCP/TP protocol to establish server and display the transport connection, according to a specified transport protocol to forward the server receives the data to the display.

Server history data query results as shown below:



**Fig.2** Historical data query

### 3.4 Display layer

Display layer mainly by the work of the display screen and quinoa traceability site consists of two parts. Work display and then receive the server to send the relevant parameters of the data and warning information after the data is displayed on the led display for staff and farmers to view; quinoa traceability site is mainly used to display information related to quinoa, such as quinoa nutrition Value, quinoa cultivation methods, quinoa food practices and other relevant information. One of the more important functions is to provide consumers and other quinoa users with a traceability query that can be queried through the identification code on the quinoa bag to find that quinoa reaches the consumer's hands from planting to growth to production and delivery.

The traceability of query result display as shown in the figure below:



The screenshot shows a web browser window with a table of query results. The table has two columns: '条目' (Item) and '数据' (Data). The data includes product name, production batch number, packaging specifications, manufacturer, shipping location, contact information, and various reports.

条目	数据
产品名称	藜麦 (一等品)
生产日期批号	20161120
包装规格	2KG/袋
生产厂商	吉林省长春市藜麦发展有限公司
发货地点	吉林省长春市
联系电话	0434-123456
邮箱	123456@163.com
存放地点	吉林省长春市
订单人库记录	<a href="#">点击查看</a>
质检报告	<a href="#">点击查看</a>
生产报告	<a href="#">点击查看</a>
种植报告	<a href="#">点击查看</a>
运输报告	<a href="#">点击查看</a>

Fig.3 The query result

## 4 Summary

### 4.1 The main achievement of this article

The system uses GPS, sensor technology and wireless network technology to set up a wireless sensor network for the production monitoring of quinoa to realize the real-time collection and storage of quinoa planting production environment information; establish the early warning model of quinoa disease based on data mining; Real-time collection of data, historical data and models and other data to establish relevant database 4; integrated WebGIS, GPS, data mining, expert systems and Internet of Things technology, developed a quinoa traceability system based on the Internet of Things.

### 4.2 The next step

- The equipment cost is higher, higher energy consumption wireless sensor



network (WSN), the next step "towards low cost and high reliability, energy-saving, environmentally friendly and intelligent five direction.

- The precision of forecasting model is not very high, the next step according to the data, the improved model, improve the model accuracy.
- The system functions and drawbacks, as further application, constantly improve and improve the system.

## Acknowledgment

The study was conducted by 2016 jilin province rural special project supported by the modern agricultural development 《Demonstration and Application of Traceable System of Quinoa Products Based on Internet of Things and 3S Technology》.

## References

1. Popkov Y V. Ethnosocial processes and ethnosocialpolicy[J]. Herald of the Russian Academy of Sciences, 82(6), 407-413(2012)
2. Liu H R, Liu X L, Yuan Y. Design and implementation of traceability system for stichopusjaponicus products[J]. Research of Agricultural Modernization, 38(5), 869-876( 2017)
3. Wang Guowei, Yan Li, Chen Guifen. The comprehensive evaluation of the spatial difference ofsoil nutrients by variable rate [J]. Journal of agricultural engineering, 10, 82-85(2009)
4. LIN Fengsheng ,FU Xiang.Quality Traceability System for Imported Food Based on Critical Control Point Analysis[J].Agricultural network information,(10), 16-18+23(2017).
5. FENG Chun-wei,GONG You-hui. FENG Chun-wei and GONG You-hui[J].Hubei Agricultural Sciences, 56(7), 3338-3341(2017)
6. Lin N, Shi W. The research on Internet of things application architecture based on web[C]// Advanced Research and Technology in Industry Applications. IEEE, 184-187(2014)
7. Chen Haiming, Cui Li, XieKaibin. Comparison of the structure and implementation of the Internet of things system [J]. computer, 36 (1), 169-170(2013)
8. Qian Zhihong, Wang Yijun. Overview of wireless sensor networks for the Internet of things [J].electronic and information technology, 1, 215-227(2013)
9. Ng A Y, Jordan M I, Weiss Y. On Spectral Clustering: Analysis and an algorithm[J]. Advances in Neural Information Processing Systems, 849-856(2001)
10. Getz G. Coupled two-way clustering analysis of gene microarray data[J]. Proceedings of the National Academy of Science, 97(22), 12079-12084(2000)
11. Wu Yuhong,TianXiaohong,TongYanan. Assessment of integrated soil fertility index based on principal components analysis.[J]. Journal of ecology, 29(1), 173~180(2010)