The Study and Application of the IOT Technology in Agriculture

Ji-chun Zhao
Institute of Information on Science and Technology of Agriculture
Beijing Academy of agriculture and forestry Sciences
Beijing, China
Zhaojichun_0@163.com

Jun-feng Zhang ; Yu Feng ; Jian-xin Guo
Institute of Information on Science and Technology of Agriculture
Beijing Academy of agriculture and forestry Sciences
Beijing, China
Zhaojc@agri.ac.cn

***Abstract*—in recent years, greenhouse technology in agriculture is to automation, information technology direction with the IOT (internet of things) technology rapid development and wide application. In the paper, control networks and information networks integration of IOT technology has been studied based on the actual situation of agricultural production. Remote monitoring system with internet and wireless communications combined is proposed. At the same time, taking into account the system, information management system is designed. The collected data by the system provided for agricultural research facilities.**

Keywords- IOT, monitoring, data collection, agriculture

I. INTRODUCTION

The IOT (Internet of Things) is a network of Internet-enabled objects, together with web services that interact with these objects. Underlying the Internet of Things are technologies such as RFID (radio frequency identification), sensors, and smart phones.

The basic idea of the IOT is that virtually every physical thing in this world can also become a computer that is connected to the Internet. To be more accurate, things do not turn into computers, but they can feature tiny computers. When they do so, they are often called smart things, because they can act smarter than things that have not been tagged[5].

Of course, one could question whether things would really have to feature computers to become smart. For instance, a consumer good could be considered to be already smart, when tagged with a visual code such as a bar code or equipped with a time-temperature indicator that, say, a mobile phone can use to derive and communicate the product's state of quality, dynamic carbon footprint, effect on diabetics, or origin. Certainly the boundary between smart things, which autonomously can derive and transform to different states and communicate these states seamlessly with their surroundings, and not so smart things, which only have a single status and are not very active in communicating it, is blurring. For pragmatic reasons, however, I will focus in this paper on smart things that are smart because they feature tiny low-end computers.

The IOT-idea is not new. However, it only recently became relevant to the practical world, mainly because of the progress made in hardware development in the last decade. The decline of size, cost and energy consumption, hardware dimensions that are closely linked to each other, now allows the manufacturing of extremely small and inexpensive low-end computers.

II. TECHNOLOGIES FOR THE INTERNET OF THINGS

The Internet of Things is a technological revolution that represents the future of computing and communications, and its development depends on dynamic technical innovation in a number of important fields, from wireless sensors to nanotechnology.

First, in order to connect everyday objects and devices to large databases and networks, and indeed to the network of networks (the internet) a simple, unobtrusive and cost-effective system of item identification is crucial. Only then can data about things be collected and processed. Radio-frequency identification (RFID) offers this functionality. Second, data collection will benefit from the ability to detect changes in the physical status of things, using sensor technologies. Embedded intelligence in the things themselves can further enhance the power of the network by devolving information processing capabilities to the edges of the network. Finally, advances in miniaturization and nanotechnology mean that smaller and smaller things will have the ability to interact and connect. A combination of all of these developments will create an Internet of Things that connects the world's objects in both a sensory and an intelligent manner.

Indeed, with the benefit of integrated information processing, industrial products and everyday objects will take on smart characteristics and capabilities. They may also take on electronic identities that can be queried remotely, or be equipped with sensors for detecting physical changes around them, even particles as small as dust might be tagged and networked. Such developments will turn the merely static objects of today into newly dynamic things, embedding intelligence in our environment, and stimulating the creation of innovative products and entirely new services.

RFID technology, which uses radio waves to identify items, is seen as one of the pivotal enablers of the Internet of Things. Although it has sometimes been labeled as the next-generation of bar codes, RFID systems offer much more in that they can track items in real-time to yield important information about their location and status. Early

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applications of RFID include automatic highway toll collection, supply-chain management (for large retailers), pharmaceuticals (for the prevention of counterfeiting) and e-health (for patient monitoring). RFID readers are now being embedded in mobile phones.

Embedded intelligence in things themselves will distribute processing power to the edges of the network, offering greater possibilities for data processing and increasing the resilience of the network. This will also empower things and devices at the edges of the network to take independent decisions. “Smart things” are difficult to define, but imply a certain processing power and reaction to external stimuli. Advances in smart homes, smart vehicles and personal robotics are some of the leading areas. Research on wearable computing (including wearable mobility vehicles) is swiftly progressing. Scientists are using their imagination to develop new devices and appliances, such as intelligent ovens that can be controlled through phones or the internet, online refrigerators and networked blinds.

The Internet of Things will draw on the functionality offered by all of these technologies to realize the vision of a fully interactive and responsive network environment.

III. The Application Of Iot Techenalogy In Agriculture

Agriculture greenhouse production environment measurement and control system is an example of IOT technology application in agriculture. The critical temperature, humidity and soil signals are collected real-time in the agriculture production process, which is transmitted by wireless networks through M2M (machine to machine) support platform. It is to gain real-time data of agriculture production environment using SMS (Short Messaging Service), web, WAP (wireless application protocol) pattern, so that the terminal can master the information to guide the production.

IV. The System Structure

Agriculture greenhouse production environment measurement and control system is made up of terminal link, business link and M2M support platform. Wire sensors can join with communication terminal directly, and then communicate with M2M support platform. Wireless sensors can communicate the M2M support platform through Radio Frequency. Operation management is charge of the service support platform, and the agriculture production monitoring system can get the greenhouse real time data which can send to the mobile terminal through SMS gateway. The structure of Agriculture greenhouse production environment measurement and control system is shown as Fig.1.

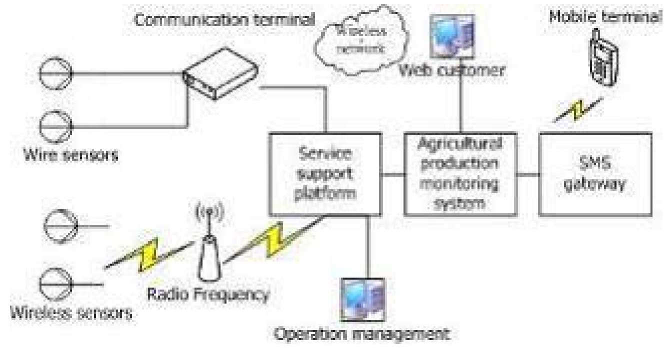

Figure 1. the structure of Agriculture greenhouse production environment measurement and control system

V. Selection And Dedign Of Hardware

The terminal link is made up of wireless communication terminal and sensor collection. The sensor can get the greenhouse production real-time data, such as temperature signal and humidity signal. The value of these physical variables can change into a low-voltage electrical signal through the transmitter, and the transmission to the wireless communication terminal.

The temperature and humidity sensor can measure the greenhouse temperature and humidity, the normal value is shown as follow.

Measurement range: -40-85 degrees, 0-100%RH.

Nominal Accuracy: 0.3 degrees, 1.5%RH.

Supply voltage: 3.5V-24VDC, recommended 5V.

The temperature and humidity sensor are shown as Fig.2.

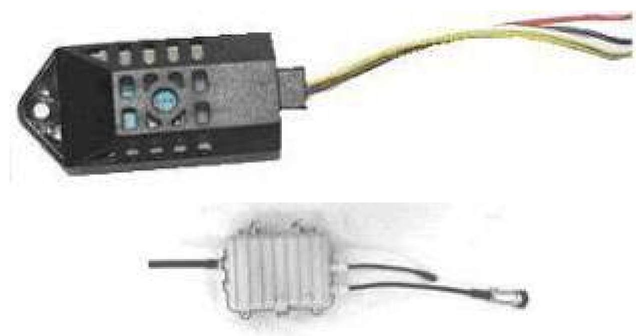

Figure 2. the temperature and humidity sensors

When the system working, the temperature sensor directly turns the temperature signal into a digital signal, and then is read out by MCU (Micro Control Unit). The humidity sensor can get the analog signal from the greenhouse air or the soil which the MCU can’t read out, so AD convertors are need to turn the analog signals into digital signals. MCU collects and process the temperature and humidity signal constantly in the whole work, and the temperature and humidity are displayed by the LCD screen. The power module provide energy to make the system work, also some other sensors can access to the MCU by RS485 interface. The sensors work principle is shown as Fig.3.

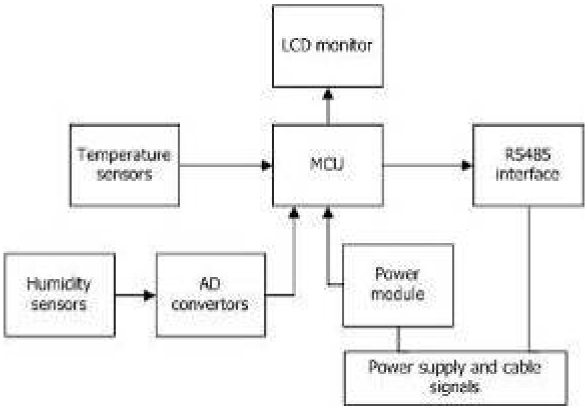

Figure 3. the sensors work principle

Wireless communication terminal is to capture the acquisition sensor signal transmitted through the wireless communication network to the standardized production of agricultural greenhouses monitoring business platform. The wireless terminal is charge of the communication between the remote control serial devices and central control system.

Wireless communication terminal is a GSM modem that supports GPRS. GPRS (General Packet Radio Service) is a packet switching technology for GSM networks. GPRS modems do not require a constant connection to the Internet as with a standard modem, because it uses the network only when there is data to be sent. GPRS offers faster data transmission and instant connections, subject to radio coverage. GPRS Modem fully enables desktop Internet applications over the mobile network. Other applications for GPRS Modems include file transfer and home automation. GPRS can be used in vehicle positioning applications to deliver several services like remote vehicle diagnostics and stolen vehicle tracking. The structure of wireless communication terminal is shown as Fig.4.

Figure 4. the structure of wireless communication terminal

VI. SOFTWARE DESIGN

The system software includes site monitoring system data acquisition software, remote data acquisition receiver software, and web application software. The site monitoring system data acquisition are made up of user interface module, network communication module, data collection module, data processing module and system configuration module. Remote data acquisition receiver is made up of user interface module, network communication module, system configuration module, and database access module, which can communicate with the site monitoring system data acquisition software through the network communication module with TCP/IP protocol. The web application software include three parts of user authentication, data access, data query and download, which access the database through ADO.NET, and the remote data acquisition can communicate with the database through ADO.NET. The user terminals can get the real time monitoring data from the web page. The software function structure is shown as Fig.4.

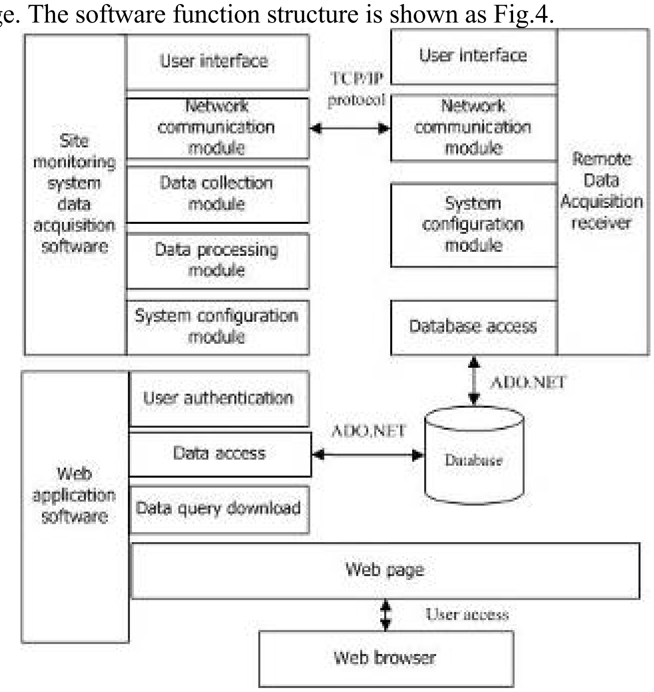

Figure 5. The software function structure

In order to ensure a reliable long distance data transmission, the system collects the data through the wireless module access to Internet using wireless transmission technology. The data is connected to the specified network database server, and the software in the database server will receive the sending data through the socket. The data are verified its legitimacy and stored in the corresponding table in the database. The business display mode is shown as Fig.5.

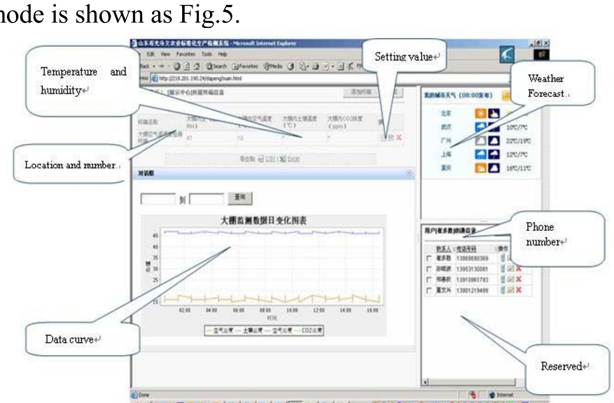

Figure 6. the business display mode

Parts of a business for customers follow the guiding ideology of simple, clear, focused and designed to show mobile. It shows customers information in a page and the information include each greenhouse each detection point real-time data of air temperature and humidity, soil temperature, 24-hour, a week, or a month's curve and so on. Customers can set alarm value, and the data can be sent to the manager's cell phone via SMS when the data is more than alarm value. Customers are free to set the number of terminals and receive SMS alerts to mobile phone number. Service platform is also reserved for the mobile publicity window, can be integrated weather forecasting, agriculture information and advertising.

VII. CONCLUSIONS

The text has studied on the IOT technology application in agriculture, and selected mobile wireless communication technology to achieve greenhouse-site monitoring. Remote monitoring system with internet and wireless communications combined is proposed. At the same time, taking into account the system management, information management system is designed. The collected data by the system provided for agricultural research and management facilities.

Research shows the greenhouse monitor system based on IOT technology has certain precision of monitor and control. According to the need surrounding monitor， this system has realized the automatic control on the environmental temperature, humidity factors. And the system has offered a good growth condition, it is easy to operate, the interface is friendly, offering the real time environmental factors in the greenhouse. It can revise environmental control parameters，this system realizes the operation online, also have these characteristics: run reliably, high performance, improve easily.

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