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The Design of Agricultural Machinery Service Management System Based on Internet of Things

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Abstract

By installing the remote monitoring terminal on the large-scale intelligent agricultural machinery and developing the related mobile application software and server software,the agricultural machinery service management system can help those special companies to provide high efficient and low-cost production services to Chinese farmers which is based on the modern technology of internet of things and cloud computer. The system can help promote the use of large-scale agricultural machinery and liberate a large number of rural labor force to participate in China's industrialization and urbanization process.

Keywords:Agricultural machinery services, Internet of Things, Cloud Platform Technology

1. Introduction

With rapid development of social economy and modern technology, Chinese agricultural production has undergone great changes. Large-scale multi-purpose farm machinery has replaced manpower and small agricultural machinery. Because of the big cost of those machinery and farmers scattered land ,the special company will be created widely which can provides the service of farmland work to those farmers with their Large-scale combined farm machinery[1]. Those company buy many large-scale multifunctional agricultural machine and provide their farmland work service to a lot of customers scattered in different areas. They must move their devices as quickly as possible to meet those farmer ’ s demands which causes a big challenge to manage those devices working effectively[2]. To solve this problem, this research introduces the technologies of the internet of things and cloud computing to develop related hardware devices and software.

The internet of things (IoT) is the internet working of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings and other items—embedded with electronics, software, sensors, actuators,

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and network connectivity that enable these objects to collect and exchange data[3].

Cloud computing is a pay-as-you-use model which provides flexible, convenient, on-demand network computing service by accessing to a configurable pool of computing resources (resources including networks, servers, storage, applications, services). These resources can be provided quickly, with minimal administrative effort or little interaction with the service provider. By this way,Companies buy only the necessary services without having to buy a lot of hardware .

Cloud computing is a distributed computing based on the technology of internet. Enterprise can buy computing service from the internet rather than buy many local computers or run data centers by themselvies.[4].

By installing a remote terminal device on the large smart agricultural machinery, the system deployed in the cloud computing platform can manage those machinery by PC,smart mobile phone and other pad devices..

2. The system architecture

IoT involves many technologies including architecture, sensor/identication, coding, transmission, data processing, net-work,discovery,etc[5].The agricultural machinery service management system takes advantages the technologies of the internet of things and the cloud computing. The architecture of this system can be seen as Fig.1.

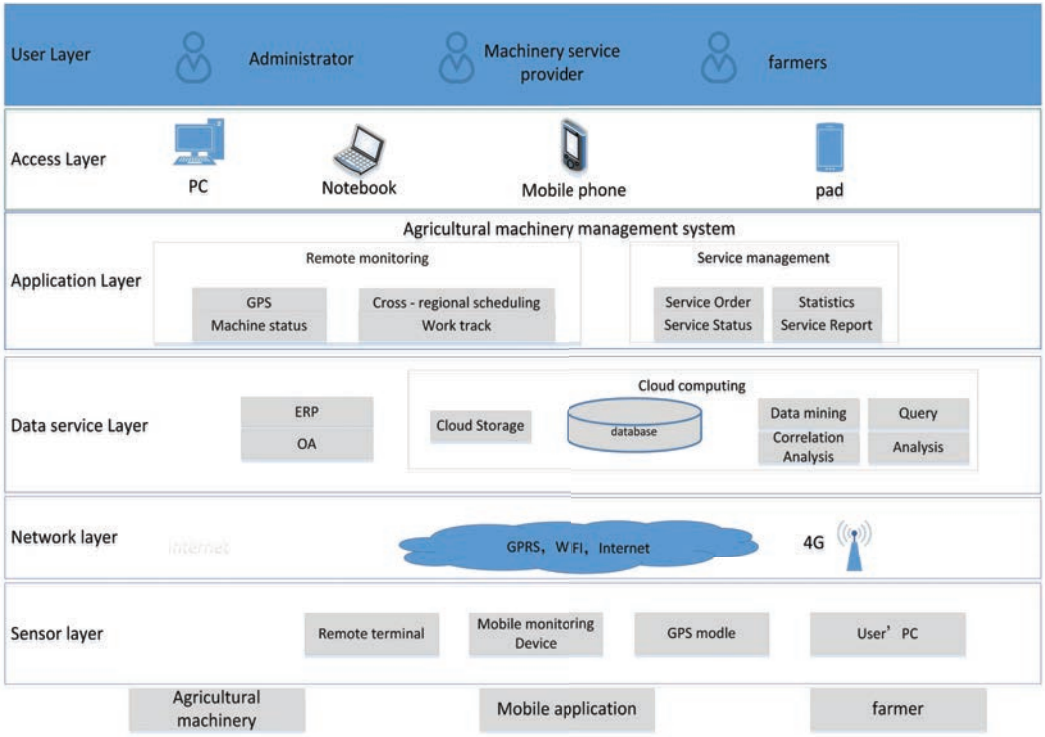

Fig. 1. The system architecture.

This system includes six layers. This first layer is sensor layer which gets all the information including the location, running status, working time of the agricultural machinery. Some service demands are also transported by farmers using client devices. The network layer provides a channel to transport information between the system and remote devices including GPRS,WIFI,Intranet and 4G mobile communication system. The data service layer processes not only the data from the device but also the data from company's ERP and OA system which is built on the cloud computing platform. All the data can be saved in cloud storage space and analyzed with the power

computing capability of the cloud platform. The application layer completes the management of a lot of large-scale agricultural machinery with the internet. The access layer includes PC,notebook,mobile phone and other smart devices which can run the application software. The user layer represents those users who can access this system. Those users can be the company’s administrator, drivers,and farmers everywhere.

3. Hardware design

In order to perceive the location and status of the agricultural machinery and send data to server, There are several components must be included in the terminal device such as MCU,GPS module,I/O module and communication module. The hardware’s structure is showing as Fig.2..

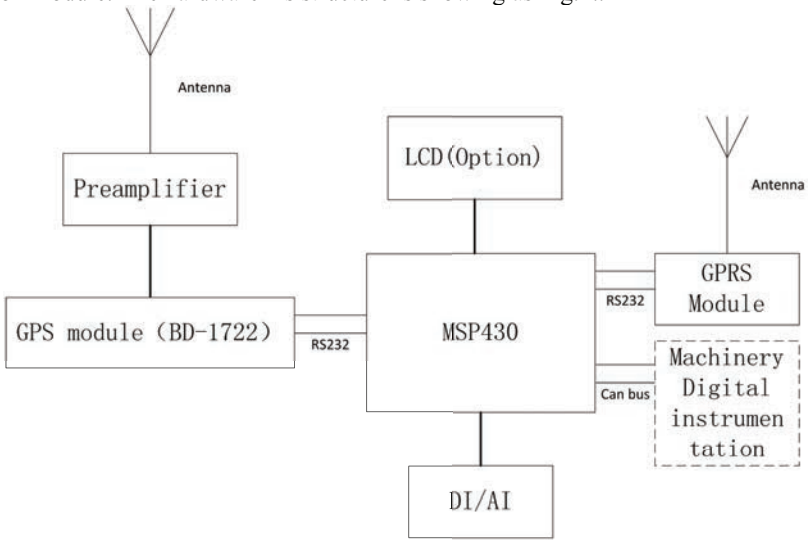

Fig.2. The structure of hardware

MCU is the main part of the device which completes basic functions including data acquisition, processing and communication. The MSP430 is selected as MCU because of its rich peripheral expansion interface, easy programming and low power consumption. This module is designed to support 8 channels AI,16 channels DI and 16 channels DO.

GPS module is a very important part of the monitoring device. The module BD-1722 is used to complete the agricultural machinery’s positioning function which supports Beidou (B1) and GPS high-performance integrated module and this module is a complete satellite positioning receiving equipment, with all-round function, to meet the stringent requirements of professional positioning and personal consumption needs. The module communicates position data to MCU with RS232 by 9600 bps.

There is a can bus to exchange data between the agricultural machinery digital instruments and MCU. Since some digital instruments have been installed into large-scale agricultural machinery,it is very easy to take advantage the can bus to get data from those instruments which represents the machine running status. Some status data without digital interface can be collected by AI/DI interface on the MCU.

When all the necessary information have been collected,the remote monitoring device will package those information into a frame data according to a common protocol and send to the application server on internet.

At last, one LCD display screen as a option can be connected to MCU to display some necessary information.

4. Software design

The agricultural machinery service company uses this system to manage their machinery and provides their farmland work to farmers.

This system is developed by VS2010 and MVC4 which is easy and quickly to complete missions and easy to expand functions. The technology of GIS and Map engine are also be used to make task plan and monitor real time status of machinery by web and application software. The program flow chart of a farmer user is shown as Fig.3 and the program flow chart of a company's user is shown as Fig.4.

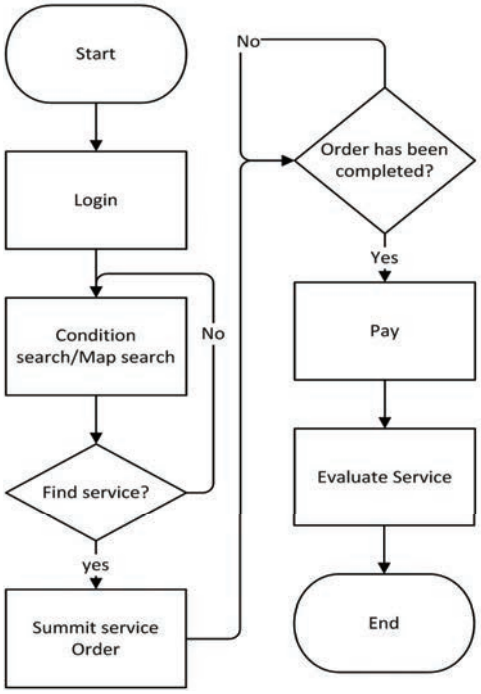

Fig.3. The program flow chart of farmer

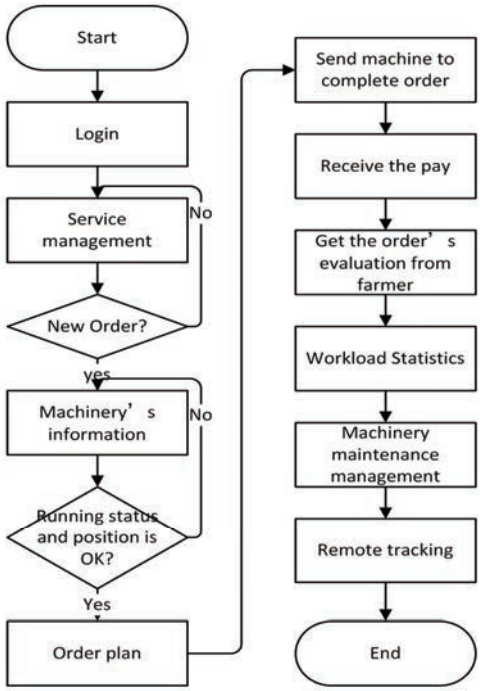

Fig.4. The program flow chart of company

5. Conclusion

With the rapid development of industrialization and urbanization in China, the agricultural population has been greatly reduced and the aging of the rural areas has led to changes in the decentralized mode of production. Since the demand for high-performance, high-quality agricultural machinery and equipment has increased year by year, agricultural service specialization become inevitable. The agricultural machinery management system Based on the Internet of Things technology, cloud platform technology and intelligent agricultural technology will greatly improve large-agricultural machinery utilization and reduce agricultural production costs and liberate a large number of rural labor force, and finally contribute to the progress of Chinese industrialization and urbanization.

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