Research on Intelligent Management Unified Service Platform of “Internet Plus Agriculture”

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Abstract: Unified intelligent management service platform based on "Internet plus", all kinds of data and status of crop growth are automatically collected by IOT. On the infrastructure platform and software platform provided by cloud computing technology, the obtained crop growth environment data are analyzed and processed by means of Hadoop ecosystem built by big data. The characteristics and patterns of ML and DL are respectively analyzed and matched according to the data of the crops collected by AI technology. After the unified summary of the results, it will be automatically pushed to the corresponding processing department, and the final processing information will be returned to the farmers serving as professional guidance. This platform is a dynamic and circular intelligent unified management system, which can realize the cross-border integration of information technology and agriculture required by "Internet plus agriculture".

1. Introduction

The essence of “Internet plus” is to make traditional industries online and digitize traditional industries, in order to give full play to the value of data by enhancing data flow[1]. "Internet plus agriculture" is to make full use of the cross-border integration of mobile Internet, cloud computing, IOT, big data, AI and other new generation of information technology and agriculture, innovating new products, models and formats of modern agriculture based on Internet platforms. It can improve the level of agricultural production and quality control, strengthen the links of agricultural production, supply and marketing, and thus improve agricultural production efficiency, quality and profits[1].

China has a vast territory and abundant resources, a huge rural area, weak Internet infrastructure, and relatively backward computers and mobile devices, especially in the economically backward central and western regions. Meanwhile, there is a general lack of specialized Internet service platform in rural areas, and the collection and release of information cannot be timely in place, resulting in relative information blocking and affecting the production and sales of agricultural products. In addition, professional and technical personnel in rural areas are relatively scarce compared with those in cities, which is also a shortcoming that restricts the development of "Internet plus agriculture". There is not only a shortage of agricultural information processing technology personnel, but also a shortage of software developers and information analysts, which causes that a large number of information resources are improperly developed and utilized. The key to "Internet plus agriculture" is to realize standardized production of agricultural products and guarantee the quality of agricultural products. However, under the current conditions, there are only a few managers in the vast rural areas, making it impossible to conduct all-round and meticulous supervision and management.

Currently, there are some e-commerce platforms in China, but they are basically at the level of "Web 2.0" characterized by sharing. It mainly plays a role in helping the sales of agricultural products on the Internet, and cannot take the initiative in collecting, processing and analyzing data of high quality. Without making full use of various new technologies of "Internet plus", it cannot meet the requirements of providing farmers with humanized and personalized services. The

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build-up of the "Internet plus agriculture" intelligent management unified service platform (hereinafter referred to as the unified service platform), it enables farmers to have a face-to-face communication with customers, experts and markets directly through the Internet, changes the role and status of farmers in circulation system beyond middlemen, and improves the interaction among farmers, customers, experts and markets. Under the support of modern logistics industry, customers can buy products directly from farmers, and farmers can also directly contact the market to sell products. The platform can automatically adjust the humidity, temperature, air pressure, light and other factors in the growing environment of crops through calculation, analysis and use of a variety of sensors to achieve the purpose of intelligent production. Through online diagnosis by experts on the platform, farmers can know the exact information whether the seeds are healthy, whether the fertilization is appropriate, whether the picking is scientific and so on. The unified service platform can also perform intelligent analysis, calculate the most economical planting type and area according to the regional planting situation and sales situation, help farmers make scientific decisions, organize production pertinently, and minimize the sales risk of products. The platform can not only omit the intermediate operation cost, reduce product price, guarantee product quality, but also realize unified supervision and management, and has the characteristics of personalized service.

2. Key technologies

2.1 Artificial Intelligence

At present, artificial intelligence technology has made great progress in natural language processing and machine vision, and it’s feasible to apply it in agricultural production can be used to identify crops and their growth state. The two main methods of artificial intelligence technology are traditional Machine Learning (ML) and Deep Learning (DL). Firstly, the training data is selected to build the model with relevant characteristics, and the training data is repeatedly adjusted and optimized. Then, the validation model is verified by the validation data input model to form a more accurate model. Finally, the real data can be input, and the trained model can be used to make a prediction and output the processing results[2]. For example, in the process of predicting whether the environment of an agricultural greenhouse is ideal for plants’ growth, which is affected by many factors, such as temperature, humidity, air pressure, light and so on, factors like these can be treated as relevant characteristics. Through machine learning, a large amount of data is input into existing models, Weights and Loss functions are constantly set for each feature, and adjustments and optimization are made continuously to finally form a model that can accurately predict the production state [2].

Deep learning is analytical learning which establishes neutral networks by imitating human brains. There are many layers and parameters in artificial neural networks. Deep learning provides a set of techniques and algorithms for parameterizing the structure of deep neural networks. Deep learning usually combines simple models together and transfers data from one layer to another to build more complex models without manual extraction on the basis of relevant characteristics [3]. For example, the Internet of things technology can be used to obtain images of crops in growth, and the platform can automatically identify various crops, as well as their growth stages and states by virtue of deep learning function. Thus, we can make horizontal comparison with the same type of crops planted by other farmers in the same region, and get the specific growth status of crops: whether they are healthy or not and whether the growth stage is ahead of or behind. Hence, the level of temperature, light, water and fertilizer will be adjusted to achieve a comprehensive control of the crop growth process.

2.2 Framework Design-Combination of Cloud Computing and Big Data Technology

As shown in Figure 1, the unified service platform adopts cloud computing and big data to design the technical framework. IaaS, PaaS and SaaS are the three layers from the bottom up. The bottom layer is the cloud infrastructure layer, which realizes the elasticity of computing, network

and storage resources. We call it Infrastructure As A Service, namely, IaaS[4]. The generation, organization and processing of big data are mainly realized through distributed file processing system. HDFS (Hadoop Distributed File System) technology of big data, namely Hadoop Distributed File System, is used in IaaS layer. Distributed file systems run on large clusters that can be built using inexpensive, generic machines and are suitable for lower-configuration computers and devices in rural areas. The whole file system adopts a pattern combining metadata centralized management and data block decentralized storage, and achieves high fault tolerance through data replication. Distributed file processing system structures in a commonly-used server, operating system or virtual machine.

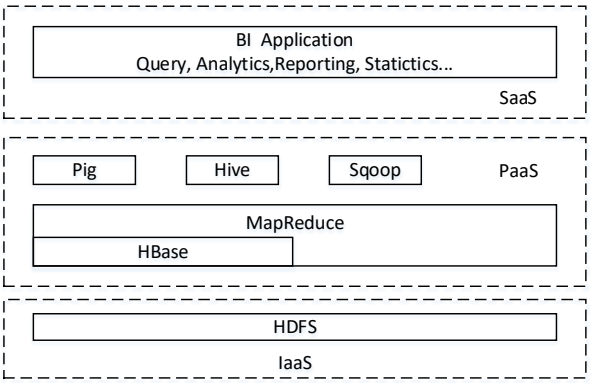

Figure 1 The framework design that combines cloud computing and big data technology.

The layer above IaaS is used to manage commonly-used applications on the platform, that is, applications with high complexity and wide area of use, such as databases. This layer is usually called PaaS (Platform As A Service). General applications such as database access applications are made into standard PaaS layer services on the cloud platform for automatic deployment [5]. In this layer, HBase, MapReduce, Pig, HIve, Sqoop and so on serve as technical supporters from the bottom up. HBase is an open source non-relational database (NoSQL database) based on column storage. It is a distributed storage system based on HDFS featuring high performance, high reliability, column storage and scalability. HBase technology can be used to build large-scale structured storage clusters on cheap PC servers, which can effectively reduce the investment cost of hardware. MapReduce is a software framework for distributed parallel computing. Based on Java functions, applications developed with MapReduce can run on large computer clusters and reliably process data clusters of Terabyte level or higher level sets in parallel. HDFS provides HBase with a reliable distributed file system, and MapReduce provides HBase with high-performance computing power. Pig and Hive provide scripting and SQL language support for cloud platforms to simplify data processing on HBase. Sqoop provides data import capabilities for HBase, making it very convenient to migrate data from traditional databases to HBase. With the support of the entire Hadoop ecosystem, HBase is organically combined with other parts to generate great computing and storage capacity.

At the top is SaaS (software-as-a-service), also known as the cloud application layer, which provides specialized Software application services on demand. These specialized software have been developed and deployed in the cloud platform in advance and are accessible to farmers by means of renting. Farmers can order the required application software services through the Internet according to their actual needs, pay fees to manufacturers according to the number and duration of the ordered services, and obtain the services provided through the Internet[5]. Instead of buying software, farmers rent software from suppliers, greatly reducing investment costs; there is no need to maintain the software. Instead, software developers are responsible for updating, maintaining and providing guidance in using the software, which also reduces the dependence on it professionals in rural areas. Leveraging the SaaS capabilities of cloud computing, a unified service platform can also provide Business Intelligence (BI) solutions for big data, which is used to effectively integrate the existing data, complete the combined functions based on query, analysis, statements and statistics, quickly and accurately put forward the basis for decision-making, and help farmers make wise

business decisions. This layer can also provide farmers with information publishing and query services to achieve the integration and sharing of agricultural information; It can provide guidance for the production and operation of agricultural products and to help farmers improve the quality of production and processing of agricultural production as well as the level of management; Derivative services of cloud application layer aim at enriching the platform system functions and providing users with more comprehensive and convenient services.

In practical applications, on the one hand, functions cloud application layer can be adjusted and extended according to the actual needs of farmers to reflect the ease application and extensibility of the platform. On the other hand, the cloud application layer realizes the effective integration of data through the PaaS layer, and can realize more accurate and efficient agricultural services and other related derivative services through big data technology, so as to enhance the huge value brought by data integration.

3. Structure design of "internet plus agriculture" intelligent management unified service platform

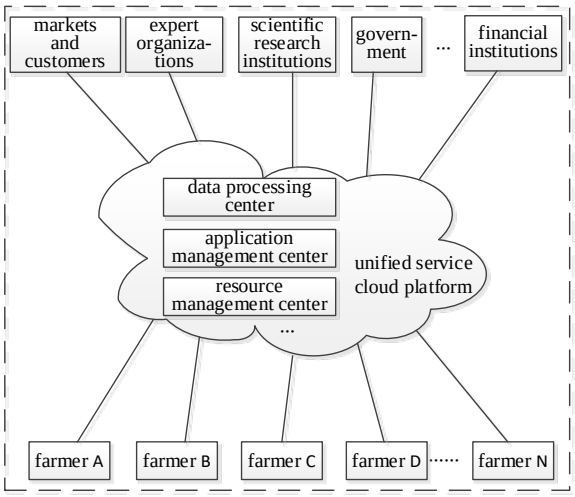

Figure 2 Logical structure design from the perspective of software service.

Structure design of "Internet plus agriculture" intelligent management unified service platform is shown in Figure 2. From the perspective of software services, all business logic of the platform can be composed into a cloud, that is, "unified service cloud platform". All core business logic such as data processing center, application management center, resource management center and so on are put into this "cloud" Cloud. This "cloud" provides all users with cloud computing software rental services, including pest control, environmental monitoring, agricultural machinery scheduling, scientific research, investment analysis, information browsing, product quality and other functions. Similarly, the platform can also provide public information and regulatory services to markets and customers, expert organizations, government departments, financial institutions, scientific research institutions and other institutions, help the government and institutions to manage farmers uniformly, help experts and scientific research institutions to obtain first-hand production status data of agricultural products for research, and help the market and customers understand relevant information that they are interested in. The unified service platform provides access to different terminals for different users in "Internet plus agriculture", such as computers, smart phones, tablet devices, apps, WeChat public accounts, QQ, etc. Also, according to the controllable strategy, practicability and convenience requirements, it provides users with diversified and personalized terminal services can meet the different needs of different users [6].

From the perspective of data flow, the logical structure of the unified service platform is designed into three layers, as shown in Figure 3. From the bottom up, there are data layer, analysis layer and processing layer. The lowest layer is the data layer, which obtains crop data of each farmer from the Internet of things, including the growth environment data of crops, such as

temperature, humidity, light, air pressure value, as well as the picture showing growth status of crops and other process data [7]. Due to the large number of farmers and the variety of crops, the data collected is huge, which is transmitted to the analysis layer through the Internet. In the analysis layer, big data technology and artificial intelligence technology should be comprehensively applied: big data technology should be used to summarize, screen, classify and sort the growth environment data of crops, and factors such as temperature analysis, humidity analysis, light analysis, air pressure analysis, soil element analysis should also be processed in such a sequence. For the state data of the growth process, machine learning and deep learning technologies of artificial intelligence are applied in the analysis layer to analyze its characteristics and pattern matching processing, so as to obtain the growth state and health level of crops. The obtained results will be statistically summarized and automatically pushed to the corresponding institutions or organizations in the processing layer, such as industry expert organizations, government departments, scientific research institutions, financial institutions, markets and customers. For the market and customers who need general analysis results only, mainly reporting to them the varieties, quantity, quality and so on of the agricultural products available for sale; the platform is a two-way interaction. The market and customers can also complain to the government departments through the platform, or directly send opinions, suggestions and other information to farmers. For the management functions of government departments, the platform mainly sends information such as resource monitoring, environmental monitoring, agricultural product safety and agricultural machinery scheduling to them. If there is any conditions that cannot meet the requirements such as pollution or pesticide use, warning information will be immediately issued to farmers through the platform, and they can be required to rectify within a specified period, which would be put on record. At the same time, the government uses the platform to carry out automatic overall planning and scheduling of agricultural machinery, and uses scientific algorithms to ensure the maximum efficiency of agricultural machinery. Artificial intelligence technology is used to match state data in the growth process, such as humidity, temperature, air pressure, light and other values, according to the established model, in order to obtain the growth state level. The specific results will be pushed to expert organizations, scientific research institutions, markets and customers, etc., so that they have a specific grasp of the agricultural products to be sold. Scientific research institutions directly obtain first-hand agricultural product data from the platform and conduct in-depth research, which plays a guiding role in the planting of agricultural products in the next season. Financial institutions can predict the future investment prospects from the operation status of farmers analyzed by the platform. Then, they can make their decisions on investment in farmers. Experts can also provide remote online advice to farmers directly through the platform by means of diagnostic function, so as to help farmers eliminate pests and diseases and cope with extreme conditions such as bad weather.

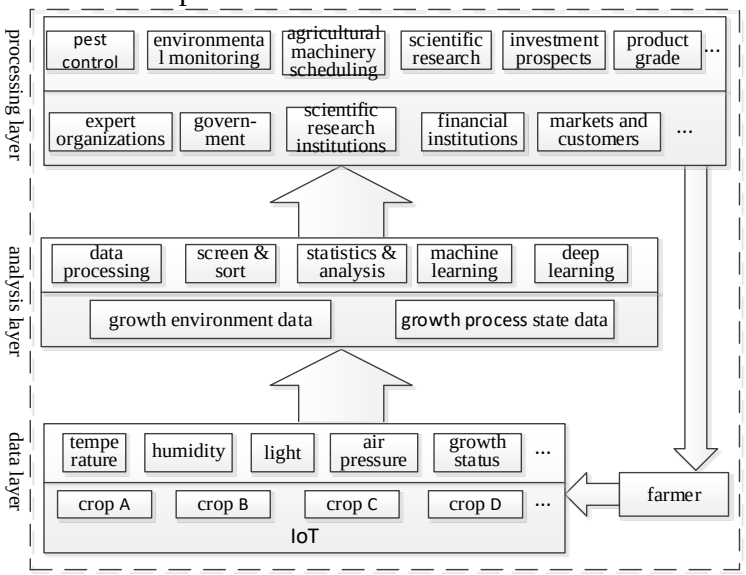

Figure 3 Logical structure design from the perspective of data flow.

On the unified service platform, according to the data flow, the data collected by the Internet of things are transmitted from the data layer to the analysis layer, and then transmitted to the processing layer after statistical analysis of big data and artificial intelligence. The defaults setting of processing layer regulates these data will be processed automatically and require no human intervention. While the important link still needs to wait in line for manual processing. The final processing results are processed by multiple agencies in the processing layer in turn, and then are transmitted from the processing layer to the farmers in the data layer. The farmer carries on the corresponding operations to crops according to the suggestions. Then a new data flow cycle is started through the Internet of things. This is a virtuous circle system of intelligent ecology, giving full play to the role of "Internet plus", greatly improving the efficiency of planting and management of agricultural products, and saving the time for farmers and multiple institutions.

4. Conclusion

Unified intelligent management service platform based on "Internet plus agriculture", all kinds of data and status of crop growth are automatically collected by IOT. On the infrastructure platform and software platform provided by cloud computing technology, the obtained crop growth environment data are analyzed and processed by means of Hadoop ecosystem built by big data. The characteristics and patterns of ML and DL are respectively analyzed and matched according to the data of the crops collected by AI technology. After the unified summary of the results, it will be automatically pushed to the corresponding processing department, and the final processing information will be returned to the farmers serving as professional guidance. This platform is a dynamic and circular intelligent unified management system, which can realize the cross-border integration of information technology and agriculture required by "Internet plus agriculture". For the goal of Internet platform’s innovation on new mode of modern agriculture, the following research content is mainly about the technical details and implementation of the platform. Due to the rapid development of the Internet, the timely application of new technologies to the modern agricultural service system will always be our goal.

References

[1] Lu Hui, Liu Wei. (2015) Application status and development countermeasures of "Internet plus" in modern agriculture [J]. Modern Agriculture Science and Technology, 15, 333-334.

[2] Pan Yunhe. (2016) Heading toward Artificial Intelligence 2.0[J].Engineering, 2(4), 409-413.

[3] Wang Wansen. (2000) Principles and Applications of Artificial Intelligence [M]. Beijing: Electronic Industry Press.

[4] Mell P,Grance T. (2011) The NIST definition of cloud computing[J].Communications of the Acm, 53(6):50-50.

[5] Hoon Choi, Sang-Hwan Lee1, Dong-In Park. (2013) Biologic Data Analysis Platform Based on the Cloud[J].International Journal of Bio-Science ＆ Bio-Technology, 3, 199-205.

[6] Feng Xian, Li Jin, Guo Meirong. (2016) Rural Information Services Mode Innovation and Service Effective Evaluation under the “Internet connect” in China [J]. Documentation, Information& Knowledge, 6, 4-15.

[7] Li Jin, Guo Meirong, Gao Liangliang. (2015) Application and innovation strategy of agricultural Internet of Things [J]. Transactions of the Chinese Society of Agricultural Engineering (Transactions of the CSAE), 31(Supp.2), 200-209.