Scholar Publishing Group
Machine Learning Theory and Practice
https://doi.org/10.38007/ML.2022.030301
ISSN 2790-0983 Vol. 3, Issue 3: 1-9

Intelligent Agriculture Decision System Based on Machine Learning

Dahai Tan*

Harbin Huade University, Harbin 150025, China

tdh000@163.com

**corresponding author*

Keywords: Machine Learning, Intelligent Agriculture, Decision-Making System, System Design

Abstract: With the continuous development and progress of science and technology, agricultural production has entered the information age. In the tide of agricultural informatization, digital decision-making and intelligent automatic management are proposed. This paper follows the pace of the times, and also proposes the design of intelligent agricultural decision-making system based on machine learning, with the aim of improving the precision marketing and cultivation of agriculture. This paper mainly uses the analytic hierarchy process (AHP) and comparative method to analyze the intelligent agriculture decision-making system through systematic experiments. The experimental results show that the accuracy and safety coefficient of the system are more than 90%, which can be normally used in agricultural decision-making system.

1. Introduction

Agricultural production decision-making is becoming more and more important in the information age. Agricultural economy, farmers' income increase and rural development are inseparable from information. It is a new method of scientific management under the modern digital technology to use information technology to realize the prediction and price control of agricultural products. Integrating computer cloud computing technology and artificial intelligence algorithm to integrate and optimize the allocation of existing resources is one of the important means to achieve the decision-making application and construction goals of China's smart farms.

There are many research theories on machine learning and intelligent agricultural decision-making system. For example, some scholars believe that smart agriculture not only improves the agricultural production management mode and agricultural production efficiency, but also promotes the sustainable and stable development of agriculture [1-2]. Some scholars also

pointed out that machine learning plays an important role in intelligent decision-making of modern agriculture [3-4]. In addition, some scholars said that the new generation of digital technology is widely used in the agricultural field, promoting the rapid development of modern agriculture in the direction of smart agriculture [5-6]. Therefore, the agricultural intelligent decision-making system integrated with machine learning algorithm in this paper uses modern technology to improve the level of agricultural development.

This paper first studies the system analysis of smart agriculture, and discusses its system composition. Then the application of machine learning in decision system is described, and the irrigation decision system is proposed. Secondly, the design of agricultural mechanization decision support system based on multi-agent is analyzed. Finally, through the system design and experimental testing system performance, draw relevant conclusions.

2. Application of Machine Learning in Intelligent Agricultural Decision-Making System

2.1. Systematic Analysis of Smart Agriculture

Agricultural decision system is a typical application of intelligent machine learning. The combination of agricultural decision-making and computer technology is the development trend of modern intelligent agriculture. It integrates information technology into the production process and realizes information sharing, real-time monitoring and control. It can analyze and process a large amount of input data, predict, diagnose and optimize control management. The data acquisition system is mainly responsible for the data acquisition of various production environments. Agricultural information collection and analysis. Collect the data of agricultural production and market demand, and predict the quantity, quality and structure of agricultural products through statistical models. The control system is mainly responsible for the operation of various controllers. Under the existing precision irrigation technology, reasonable and effective fertilizers are selected in combination with crop growth characteristics to control the drip irrigation time and ensure good growth environmental conditions for crops [7-8]. According to the soil water and salt conditions in different regions, the corresponding planting density and yield indicators are formulated, and the monitoring database information database is regularly updated to meet the real-time dynamic data processing needs. The system mainly includes data collection module, electronic map navigation module and user interface. On this basis, the corresponding function design needs to improve the existing technology and finally complete the intelligent production mode.

Information processing of agricultural production is the most important, critical and basic link in the intelligent agricultural decision-making system. Its main tasks are as follows. Real time monitoring of crop growth environment. Through the data collection and analysis of the natural environment characteristics of crops in different cultivation stages and the properties of the objects sown, we can understand the changes of soil physical and chemical properties in different periods of crop cultivation. According to the obtained relevant meteorological data and other agricultural production factor information, determine the crop growth cycle and yield trend, and formulate reasonable yield increase measures and variety structure optimization plan. The existing agricultural products shall be classified and managed at different levels. According to the production characteristics of agricultural products, the main influencing factors are analyzed and determined. Formulate corresponding countermeasures according to the analysis results, realize modular design of management and control functions, and ultimately improve work efficiency and accuracy [9-10].

2.2. Application of Machine Learning in Decision System

In the agricultural IoT system based on wireless sensor network, special deployment is required

for the intelligent irrigation decision-making subsystem, in which the monitoring center and communication module are the common parts. The hardware of intelligent irrigation decision-making subsystem includes pipeline flowmeter, battery valve and solenoid valve controller, which are mainly used to execute irrigation instructions and realize automatic irrigation of farmland. The intelligent irrigation decision-making subsystem not only needs to carry out expert system analysis on data samples collected by farmland sensors, but also needs to collect additional information to establish an accurate irrigation model [11-12].

Machine learning algorithm can process complex data through different models, making numerical prediction or classification achieve high accuracy, which is the best model choice. HHT is most suitable for processing this type of data, converting precipitation into a form suitable for machine learning modeling, and improving the accuracy rate in general. Since the precipitation prediction model requires long-term precipitation sample statistics, it is necessary to obtain comprehensive precipitation data from meteorological stations, which is characterized by long time and accurate data [13-14].

Generally, when the frequency of data curve is lower, it means that the curve is more gentle. Theoretically, the curve model fitted is simpler. On the contrary, the higher the frequency, the greater the curve volatility. When the peak value fluctuates, the curve model fitted will become more complex. The time series data is mathematically expressed as:

$$\{a_1 a_2 \Lambda\ a_s\}, s \in [1, S] \tag{1}$$

The precipitation a_s at the current time is taken as the prediction value. The time-based prediction model is expressed as:

$$a_s = g(a_{s-1}, a_{s-2}, \Lambda\ , a_{s-l}), l \in [1, S-1], s \in [1, S] \tag{2}$$

Among them, l is the number of inputs. In general, after confirming the input variables and prediction variables, select appropriate functional models according to their characteristics, compare, analyze and evaluate the performance of each model, and select the best model as the final prediction model. Since precipitation is a nonlinear and non-stationary process, which is interfered by many factors, the prediction accuracy of data directly used for function modeling will be affected to some extent [15-16].

2.3. Design of Agricultural Mechanization Decision Support System Based on Multi-Agent

The agricultural mechanization decision support system using multi-agent is to abstract the functions of agricultural mechanization system analysis and comprehensive evaluation into one or more agents, and complete the analysis and evaluation of complex agricultural mechanization system through communication and mutual negotiation between functional agents. This provides an intelligent human-computer interactive information system for scientific decision-making of agricultural mechanization managers [17-18].

Agricultural mechanization system is a complex system. In order to ensure the correctness and robustness of system analysis and comprehensive evaluation, and the relative independence of system functions, during the development and design process, according to the different functions of service modules, the system functions can be packaged as multiple agents with loose structures, and multiple agents can cooperate with each other to complete a task. In the system design, in order to ensure the availability, scalability and operating efficiency of the agricultural mechanization decision support system, the system should meet certain design principles and non functional requirements while realizing the functional requirements, and design under the guidance of the

design principles. First of all, a multi-agent development platform is designed to provide a technical platform for the system to run. Secondly, according to the different functions of agents, the responsibility scope of agents is divided, and the structure of functional agents is given. Third, according to the comprehensive requirements of the agricultural mechanization decision support system, design the appropriate software architecture and divide the level of system functions.

The system design follows the following principles:

System practicability. Whether the system is practical or not is an important sign of the success of software design. This system provides guidance for agricultural production and auxiliary decision-making for scientific management and decision-making level of agricultural mechanization. The accuracy and timeliness of system processing. The openness and expandability of the system. The system is developed using multi-agent technology to ensure the scalability of the system. Ease of use and maintainability of the system. In addition, the system provides data backup and recovery tools. Performance indicators of the system. The system availability is greater than 96%, and the system statistics and query time is less than 15 seconds.

3. Design of Intelligent Agriculture Decision-Making System

3.1. Overall Function Design of the System

The FMSIDSS based on Web is developed. The system mainly has four main functional modules: intelligent decision-making module, information browsing module, system maintenance module and expert scoring module. The functional diagram of the system is shown in Figure 1.

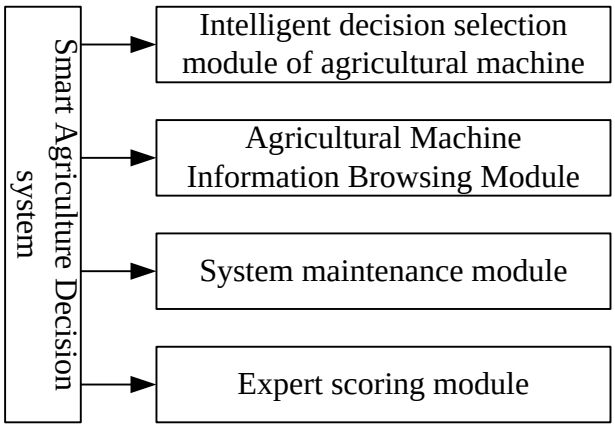

Figure 1. Smart agriculture decision system

The intelligent decision-making module is divided into two modules: power machine selection decision-making and operating machine selection decision-making. The power range is obtained by the power machine selection decision module according to the search and matching rules. The intelligent decision-making module for the selection of the operating machine inputs the planting situation and selects the category of the operating machine. This is a big data analysis platform based on Internet of Things technology. The application aims to achieve intelligent decision-making and improve production level according to the needs of agricultural industrialization and smart agriculture development. First, we need to collect agricultural product information and crop growth and other parameters. Then, using the Internet of Things technology to build a model library in the whole life cycle from seed to final product and apply it to the monitoring of crop production process. Finally, according to the actual data, the decision model of agricultural producers and consumers

based on sample neural network is established.

3.2. System Development Environment and Tools

Software environment for the system development:
User environment: Microsoft Internet Explorer 7
Network service environment: Windows NT6.0/1IS 7.0MTS and SQL, Scrver 2017 database
Professional development environment: Visual Basic.NET
Auxiliary development environment: Maatab9.0, Phatoshop, CsDreamvweaver MX and Fash MX

Visual Studio is selected for this system NET as a program development tool. Visual Studio. NET adds support for XML Web Services development.

3.3. System Test

The database connection test is mainly to check whether the developed software system platform can accurately interact with the database. The key to system interface testing is to see whether the style of the system interface can meet the user's requirements, whether there are errors in the text, and whether the page looks good. The purpose of control module testing is to detect whether the hardware equipment can make correct response to the corresponding instructions in the software system. The data security test mainly simulates the simultaneous use of multiple gateway nodes in a short period of time to see whether the system data is lost.

4. Analysis of Test Results

4.1. Test Results of System Responsiveness

According to the relevant decision-making monitoring system designed in this paper, data analysis and monitoring were conducted for agricultural related events, and the results in Table 1 were obtained. Table 1 describes the operation level, benefit level, structure level, scale level and economic level of agriculture in recent years.

Table 1. Agricultural development level system test reaction capacity

	Weight	Average value	Time
Operation	0.32	2.41	2.4
Scale	0.12	2.64	2.7
Benefit	0.24	2.55	2.6
Structure	0.18	2.52	2.5
Economy	0.19	2.46	2.4

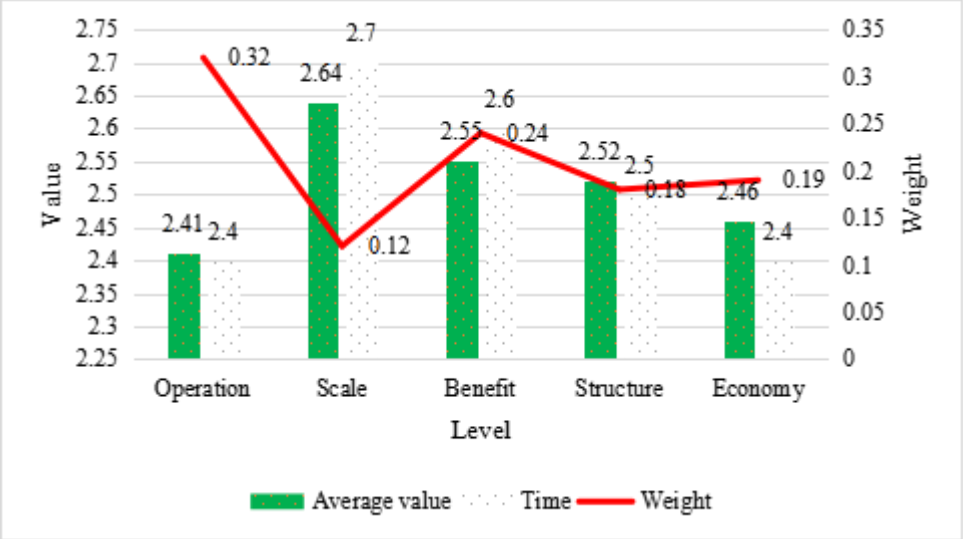

Figure 2. Agricultural development level system test reaction capacity

As shown in Figure 2, we can see that the system's response time for analysis and calculation of agricultural related data is controlled within 3s. In addition, we can see that the factors that affect agricultural development can start from their operation level. According to the system calculation, the operation level and benefit level are the most important influencing factors in the agricultural decision-making system.

4.2. System Performance Test Results

According to the principles of system design and experimental data in this paper, Table 2 can be obtained. Table 2 shows the test results of system performance. Among them, the system performance indicators include the accuracy, error rate and security of the system. In addition, this system focuses on intelligent decision-making, information browsing, system maintenance and expert scoring modules.

Table 2. System performance test results

	Accuracy	Error	Safety
Intelligent decision-making	96.2	3.8	92
Information browsing	98.5	1.5	95
System maintenance	97.8	2.2	93
Expert scoring	99.7	0.3	90

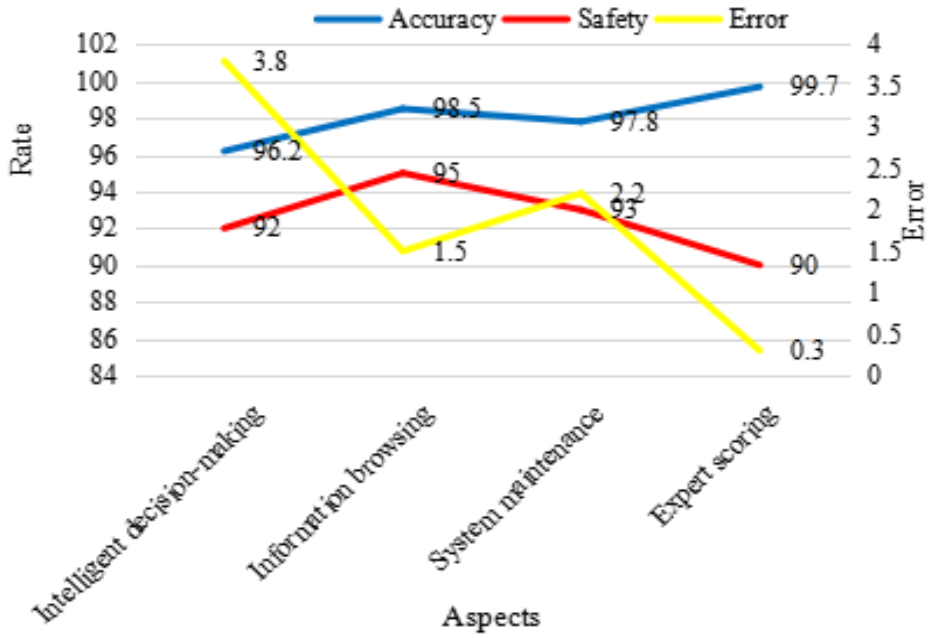

Figure 3. System performance test results

As shown in Figure 3, we can see that the accuracy of the intelligent agricultural decision-making system in data processing can reach more than 96%, and the security performance can also reach more than 90%. Therefore, the system designed in this paper can meet the needs of agricultural development, and its security also makes the system more convincing.

5. Conclusion

With the wide application of Internet technology, more and more intelligent decision-making systems based on big data analysis models emerge as the times require. Agricultural decision-making system is a method based on artificial intelligence technology, oriented to agricultural development pattern recognition and intelligent analysis. It combines modern information with human experience to process complex data. This paper analyzes the problems of the existing agricultural decision-making system, and combines the current mainstream network technology, based on the Web composition model, to establish an efficient and targeted collaborative development system. This paper puts forward its own ideas on the new trends in the agricultural field.

Funding

This article is not supported by any foundation.

Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

References

[1] *Et-Taibi Bouali, Mohamed Riduan Abid, El-mahjoub Boufounas, Tareq Abu Hamed, Driss Benhaddou: Renewable Energy Integration Into Cloud & IoT-Based Smart Agriculture. IEEE Access 10: 1175-1191 (2022). https://doi.org/10.1109/ACCESS.2021.3138160*

[2] *Muhammad Shoaib Farooq, Rizwan Javid, Shamyla Riaz, Zabihullah Atal: IoT Based Smart Greenhouse Framework and Control Strategies for Sustainable Agriculture. IEEE Access 10: 99394-99420 (2022). https://doi.org/10.1109/ACCESS.2022.3204066*

[3] *Sameer Qazi, Bilal A. Khawaja, Qazi Umar Farooq: IoT-Equipped and AI-Enabled Next Generation Smart Agriculture: A Critical Review, Current Challenges and Future Trends. IEEE Access 10: 21219-21235 (2022). https://doi.org/10.1109/ACCESS.2022.3152544*

[4] *Ryota Ishibashi, Takuma Tsubaki, Shingo Okada, Hiroshi Yamamoto, Takeshi Kuwahara, Kenichi Kawamura, Keisuke Wakao, Takatsune Moriyama, Ricardo Ospina, Hiroshi Okamoto, Noboru Noguchi: Experiment of Integrated Technologies in Robotics, Network, and Computing for Smart Agriculture. IEICE Trans. Commun. 105-B(4): 364-378 (2022). https://doi.org/10.1587/transcom.2021WWI0001*

[5] *Dushyant Kumar Singh, Rajeev Sobti, Anuj Jain, Praveen Kumar Malik, Dac-Nhuong Le: LoRa Based Intelligent Soil and Weather Condition Monitoring with Internet of Things for Precision Agriculture in Smart Cities. IET Commun. 16(5): 604-618 (2022). https://doi.org/10.1049/cmu2.12352*

[6] *Keyurbhai A. Jani, Nirbhay Kumar Chaubey: A Novel Model for Optimization of Resource Utilization in Smart Agriculture System Using IoT (SMAIoT). IEEE Internet Things J. 9(13): 11275-11282 (2022). https://doi.org/10.1109/JIOT.2021.3128161*

[7] *Hitesh Mohapatra, Amiya Kumar Rath: IoE Based Framework for Smart Agriculture. J. Ambient Intell. Humaniz. Comput. 13(1): 407-424 (2022). https://doi.org/10.1007/s12652-021-02908-4*

[8] *Merihan E. Amr, Amr A. Al-Awamry, Marwa A. Elmenyawi, Adly S. Tag Eldien: Design and Implementation of a Low-cost IoT Node for Data Processing, Case Study: Smart Agriculture. J. Commun. 17(2): 99-109 (2022). https://doi.org/10.12720/jcm.17.2.99-109*

[9] *Kamila Koteish, Hassan Harb, Mohammad Dbouk, Chamseddine Zaki, Chady Abou Jaoude: AGRO: A Smart Sensing and Decision-Making Mechanism for Real-Time Agriculture Monitoring. J. King Saud Univ. Comput. Inf. Sci. 34(9): 7059-7069 (2022). https://doi.org/10.1016/j.jksuci.2022.06.017*

[10] *Kaneez Fizza, Prem Prakash Jayaraman, Abhik Banerjee, Dimitrios Georgakopoulos, Rajiv Ranjan: Evaluating Sensor Data Quality in Internet of Things Smart Agriculture Applications. IEEE Micro 42(1): 51-60 (2022). https://doi.org/10.1109/MM.2021.3137401*

[11] *Lizy Kurian John: Smart Agriculture and Smart Memories. IEEE Micro 42(1): 4-6 (2022). https://doi.org/10.1109/MM.2021.3138625*

[12] *Prabhat Kumar, Govind P. Gupta, Rakesh Tripathi: PEFL: Deep Privacy-Encoding-Based Federated Learning Framework for Smart Agriculture. IEEE Micro 42(1): 33-40 (2022). https://doi.org/10.1109/MM.2021.3112476*

[13] *Faisal Karim Shaikh, Mohsin Ali Memon, Naeem Ahmed Mahoto, Sherali Zeadally, Jamel Nebhen: Artificial Intelligence Best Practices in Smart Agriculture. IEEE Micro 42(1): 17-24 (2022). https://doi.org/10.1109/MM.2021.3121279*

[14] *Sudip Misra, Neeraj Kumar: Special Issue on Artificial Intelligence, Edge, and Internet of Things for Smart Agriculture. IEEE Micro 42(1): 6-7 (2022). https://doi.org/10.1109/MM.2021.3137537*

[15] D. P. Acharjya, R. Rathi: An Integrated Fuzzy Rough Set and Real Coded Genetic Algorithm Approach for Crop Identification in Smart Agriculture. Multim. Tools Appl. 81(24): 35117-35142 (2022). https://doi.org/10.1007/s11042-021-10518-7

[16] Dixon Vimalajeewa, Chamil Kulatunga, Donagh P. Berry, Sasitharan Balasubramaniam: A Service-Based Joint Model Used for Distributed Learning: Application for Smart Agriculture. IEEE Trans. Emerg. Top. Comput. 10(2): 838-854 (2022).

[17] K. Lova Raju, V. Vijayaraghavan: A Self-Powered, Real-Time, NRF24L01 IoT-Based Cloud-Enabled Service for Smart Agriculture Decision-Making System. Wirel. Pers. Commun. 124(1): 207-236 (2022). https://doi.org/10.1007/s11277-021-09462-4

[18] Abhishek Srivastava, Dushmanta Kumar Das: A Comprehensive Review on the Application of Internet of Thing (IoT) in Smart Agriculture. Wirel. Pers. Commun. 122(2): 1807-1837 (2022). https://doi.org/10.1007/s11277-021-08970-7