Agricultural water management based on the Internet of Things and data analysis

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ABSTRACT
To improve the effect of agricultural water management, this paper builds an agricultural water management system based on the Internet of Things and data analysis, and designs an intelligent analysis model of the system using the method of time series forecasting. Moreover, this paper designs the software and hardware of the ZigBee wireless sensor network monitoring node, including the hardware circuit design of the ZigBee network monitoring node and the software acquisition program design to realise the data acquisition and short-distance transmission of the farmland environment. In addition, this paper designs a farmland irrigation system based on the Internet of Things, which can also realise real-time monitoring of agricultural water quality. Finally, this paper designs an experiment to analyse the performance of the system constructed in this paper. Judging from the performance of the agricultural water management system, it can be seen that its performance can meet the actual needs of agricultural water management.

Introduction
The use of automated control technology in the irrigation of plants will greatly reduce the waste of water resources, increase the utilisation rate, and at the same time provide the best growth environment for plants to increase production and improve the quality of food. A system integrator as well as material handling system supplier such as design, build, and install together with electrical, software in addition to mechanical that gives total turn-key framework answers for the material dealing with industry is termed as automated control technology (ACT). It can give plan arrangements our own transport product offerings besides coordinate different fabricates gear depending on the situation. It has items like our plate else container transport like MotionRoll, plate else container and all-inclusive sorters like MotionSort, in addition to standard as well as custom mass transport items. However, because China’s economic foundation is not strong, China has long insisted on focusing on economic construction, while ignoring agricultural investment. It is precisely because of these reasons that China’s agricultural infrastructure construction has been in a lagging state for a long time, and the automation and intelligent equipment in irrigation are scarcer (Archibald and Marshall 2018). However, in foreign developed countries, their industrialisation process far surpassed our country’s decades or even hundreds of years, and the long-term industrialisation development has given them a solid economic foundation. Therefore, they have entered the development stage of industry nurturing agriculture ahead of schedule. In this regard, they are at least ahead of our decades of experience. At present, irrigation technology has shifted from mechanical irrigation methods such as sprinkler irrigation and drip irrigation to automated and precise management, and it has shifted from real-time monitoring and forecasting to automatic irrigation automation (Gao et al. 2020). Dribbling valves are available in trickle framework while shower firearms as well as spouts are utilised in sprinkler irrigation framework. Just the root region is wetted through dribble water system, although one sprinkler wets a space of a circle, which covers various plants. The objective is to put water straightforwardly into the root zone as well as limit dissipation. Dribble water system framework decreases water utilisation by half. With dribble water system, water applications are more regular which gives a better dampness level for the plants to flourish. The current commonly used
and implemented systems usually collect some basic plant growth factors to realise automatic and precise irrigation management. For some more precise irrigation control systems, more factors are considered, and the technological content is very high (Ashofteh et al. 2017). From the perspective of precision irrigation systems in some advanced countries, if we want to truly achieve precision irrigation, it is impossible to control the amount of irrigation water alone. It is also necessary to comprehensively consider the plant growth process to truly realise precise irrigation. For developing countries, the cost of irrigation equipment is an important factor to be considered. Because the price of the equipment is generally more expensive, it is almost impossible to directly import it from developed countries. However, since the 1990s, the concept of the Internet of Things has been proposed. At the beginning, due to the constraints of sensing and network transmission technologies, the application of the Internet of Things was not widespread. However, with the further development of the two, the Internet of Things technology has also ushered in a new starting point. Up to now, in our daily life, there are applications of the Internet of Things in all aspects of our daily life, ranging from the industrial production connection, and second, it can realise information sharing in some more complex terrain (a range that cannot be covered by wired networks and mobile phone communications). The current agricultural development trend in my country is from traditional agriculture to modern agriculture. The emergence of intelligent equipment has broken the traditional agricultural production method and is an inevitable trend of agricultural development. In the so-called smart agriculture, its wisdom is reflected in the automation of agricultural production and the intelligent positioning of agricultural information (Gao et al. 2020). The emergence of smart agriculture has accelerated the upgrading and transformation of the agricultural industry chain, which can improve the accuracy of agricultural production, promote high efficiency and green development, and is also a way to ensure the health of agricultural products, improve agricultural competitiveness and promote sustainable agricultural development. The development of smart agriculture is inseparable from the development of related technologies of the Internet of Things. The development of the Internet of Things drives the development of smart agriculture. However, there are also some problems that need to be resolved in the development process, such as high cost, low reliability and difficulty in development. This requires the country to increase its attention to the development of smart agriculture.

This article combines the Internet of Things and data analysis technology to build an intelligent agricultural water management system, and build an intelligent model to conduct internal work test research to improve the subsequent agricultural water management efficiency (Kaur et al. 2021).

The main objective of this paper is based on the IoT (internet of things) and data analysis, the construction of agricultural water management system is taken. Further, by using the technique of time series forecasting, an intelligent analysis model has been designed. To realise the data acquisition besides short-distance transmission of the farmland environment, the software as well as hardware process of Zigbee technology then the software acquisition program is calculated. Also, IoT is utilised to design the farmland irrigation system which is to realise the real-time monitoring of agricultural water quality. Finally, the performance of the framework is analysed by using the design experiments.

Related work

The computer control has high accuracy and strong operability for users, which greatly reduces the waste of human resources. Boretti and Rosa (2019) proposed a method to improve the water production function to adapt it to the local planting environment for irrigation guidance. Cotterman et al. (2018) applied the CERES-Rice model to analyse the effect of soil water availability on the potential of dry-farming rice in Bangladesh and determined the effect of soil water stress on the potential yield at the regional scale during the transplanting period.

Fu et al. (2018) and Li et al. (2019) conducted experiments on the hydrogeological conditions of dry-farming rice, and constructed a model, which well expresses the relationship between hydrological processes and rice yield.

Gu et al. (2017) successfully developed a small automatic irrigation control system. The system can monitor the water level information of the rice field in real time and control the opening and closing of related equipment with the single-chip microcomputer as the core to complete the irrigation function of crops. This automatic irrigation system has low cost, flexible control method and good irrigation effect.
Guzman et al. (2017) used eight methods to calculate rice evapotranspiration and compared the calculated results with the measured values. The research results show that although eight methods are used for calculation, the evapotranspiration calculated by the eight methods all have the same changing trend.

Javadinejad et al. (2019) took rice in a semi-arid environment as the research object and studied the radiation use efficiency under different plant densities. Moreover, it also studied the water use efficiency under different irrigation methods, and then concluded that a reasonable and thorough irrigation method is much better than traditional farming methods. Jia et al. (2017) and Nguyen et al. (2020) conducted experimental research on rice irrigation areas and found that traditional irrigation methods caused a lot of waste of water resources, and 50% of the water volume was field leakage.

Karbasi (2018) proposed four aspects: sustainable development, ecological quality, consideration of the impact of macro-scale systems and planning of natural and social systems. That is to incorporate the water resources system into the environmental requirements of human survival and future changes, and into the strategic position of the healthy development of the entire society. In Africa, due to the lack of water resources, the food produced in agriculture cannot meet the needs of the population, posing a great threat to future economic development. Myronidis et al. (2018) analysed the impact of two irrigation districts being transformed from the government department responsible for irrigation management to the water user federation responsible for irrigation management. Moreover, the impact is evaluated in terms of financial feasibility, sustainable development of infrastructure, irrigation operations and agricultural productivity. Based on the experience and practice of water user associations on a global scale, Nayak et al. (2018) and Nguyen et al. (2016) argue and analyse the incentive effect of establishing water user associations (WUAS) on farmers. The emphasis is on the importance of motivating participation in the organisation, and various types of incentives have been studied. Peng et al. (2018) analysed the role of farmers participating in irrigation management decision-making through empirical analysis, conducted a comparative analysis before and after the implementation of different organisational models, and pointed out the role of establishing farmers’ cooperative economic organisations.

Quilty et al. (2019) used the method of marginal product value to analyse the economic benefits of irrigation areas. Moreover, it believed that in areas with insufficient water resources, water distribution should be optimised according to water resources and water production functions, and economic water use should be implemented to maximise the total output or total income of the irrigation area. On this basis, Rodriguez et al. (2018) and Shakeel et al. (2021) applied the theory of non-linear planning to discuss the economic benefits of irrigation under the condition of the combined use of multiple water sources in the irrigation area. Sheffield et al. (2018) carried out a dynamic change and horizontal comparative analysis of the utilisation structure and efficiency of water resources in Northwest China, and calculated and analysed the sources of water resources required for the growth of output value in Northwest China. Srivastava (2017) applied the optimisation principle of ‘equal marginal utility’ in economics based on estimating crop production functions, and derived a mathematical model for optimising the output value of the planting industry when the output value is lost due to the lack of water based on the principle of equal marginal losses of all crops, so as to solve the problem of how to allocate limited water to various crops to maximise the total output value. Tiwari and Adamowski (2017) believed that the fundamental way to improve water use efficiency is to develop water-saving agriculture. The specific methods include water-saving by biotechnology, adjustment of crop spatial layout, sewage resource utilisation and water resource price adjustment.

Research on TMDL model parameter optimisation and decision control based on supercomputing platform

This paper comprehensively considers the socio-economic development status of the study area and the needs of food security to establish a TMDL (total maximum delay load) for studying farmland non-point source nutrient pollution, which is combined with target total control. A TMDL regulates a pollutant reduction target and assigns load reductions to source of pollutant. Moreover, this paper proposes a total nitrogen and phosphorus nutrient control distribution plan, and proposes a total nitrogen and phosphorus nutrient pollution source load distribution plan for the control unit. Non-point source contamination is more enthusiastically to recognise as well as harder to address. Simultaneously, it is contaminated as of several spots. The point source contamination is characterised by United States Environmental Protection Agency (EPA) as any toxin that enters the climate from an effortlessly distinguished as well as
restricted spot. On the off chance that contamination prompts mass kick the bucket off of fish besides messy looking water, profound monetary misfortunes frequent outcome. It influences the magnificence as well as soundness of seaside terrains and waters.

(1) Research on the distribution plan of pollutant emission in the whole basin based on the environmental carrying capacity of the control unit

When carrying out the comprehensive treatment of water resources in the whole river basin, it is necessary to take into account the water needs of various regions and also to strictly restrict the discharge of various pollutants. At the same time, due to the externality of pollutants, a reasonable allocation of pollutant emissions in different regions and strengthening of monitoring is inevitable ways to conduct comprehensive management.

Based on comprehensively determining the optimal emissions in each region, this study uses the regional water environment carrying capacity index given above to construct an optimal model and calculate the quantitative distribution plan of pollutant emissions in each region.

The objective function is (Yaseen et al. 2018; Kumari et al. 2019)

\[
\min \sum_{k=1}^{K} w_k | f_k(u) - p_k(X_k) |
\]  

(1)

In the above formula, \( f_k(u) \) represents the optimal water environment carrying index of the \( k \)th area under its current social, economic and environmental conditions, and \( p_k(X_k) \) refers to the water environment carrying index of the \( k \)th area under a given pollutant discharge amount \( X \) and \( w_k \) is the water environment weight of the \( k \)th area in the whole watershed environment. The constraints are:

(1) The overall emission limit of the whole basin is

\[
\sum_{k=1}^{K} X_k \leq X^\text{max}
\]  

(2)

(2) The emission limit in each region is

\[
X_k \leq X_k^\text{max}
\]  

(3)

(3) The limit on the number of upstream and downstream adjacent areas is

\[
b_{k-1}X_{k-1} + X_k \leq X_k^\text{lim}
\]  

(4)

(4) Other restrictions are

\[
f_k(X_k) \leq G \quad (5)
\]

\[
X_k \geq 0 \quad (6)
\]

(5) Research on the comprehensive pollution control of the whole river basin based on multi-objective optimisation theory

A space of different rules, dynamic, concerning numerical streamlining issues including more than one target capacities to be upgraded at the same time is termed as multi-objective optimisation theory. It is otherwise called as vector streamlining, multi-objective programming, else Pareto enhancement. It has been seen as a typical apparatus to address supportability issues. Multi-objective optimization (MOO) has perceived to address sustainability problems and the MOO models solution is given by Pareto front which requires decision-makers. The comprehensive pollution control of the whole river basin takes the effectiveness and investment of comprehensive control as the objective function and takes the social, economic development and water environment maintenance of the control objects as constraints to construct a governance model.

The performance goals are (Zubaidi et al. 2020)

\[
\max f_1(X) = \sum_{k=1}^{K} p_k(X_k)
\]  

(7)

In the above formula, \( p_k(X_k) \) is the increase in the water environment carrying capacity index obtained by the \( k \)th area after the input of \( X_k \) treatment, and \( g \) represents the input of the \( k \)th area. \( X_k \) represents the input amount of the \( k \)th area.

The investment goal is

\[
\min f_2(X) = \sum_{k=1}^{K} V_k(X_k)
\]  

(8)

In the above formula, \( V_k(X_k) \) is the total value of the \( k \)th area paid by the entire area after the input of \( X_k \) treatment, and \( X_k \) represents the amount of input in the \( k \)th area.

The constraint of the general objectives of the management of the whole river basin is

\[
\sum_{k=1}^{K} E_k(X_k) \leq E
\]  

(9)

In the above formula, \( E_k(X_k) \) represents the amount of pollution still retained after the input of \( X_k \) in the \( k \)th area, and \( E \) represents the maximum amount of pollution allowed in the whole river basin.
The regional carrying capacity constraint is
\[ Q_k(X_k) \leq Q^*_k \] (10)
In the above formula, \( Q_k(X_k) \) represents the amount of pollution still retained in the kth area after the input of \( X_k \), and \( Q^*_k \) represents the maximum amount of pollution allowed in the area.

**Proposed water management system with IoT**

The system should realise the following functions: (1) it can detect soil moisture, ambient temperature and caring moisture in real time, and upload it to the computer and mobile App control software in real time via the wireless network. (2) The wireless node can automatically open or close the solenoid valve in time depending on the set threshold. (3) Computer and mobile phone App host computer software can record and display moisture information in the irrigation area in real time and can be controlled manually or automatically according to the physiological characteristics of different plants. (4) The entire design uses solar power to prevent the inconvenience of laying the line in the field, and the aesthetic impact and damage caused to the lawn and vegetation after laying. The functional structure diagram of the entire system is shown in Figure 1.

![Figure 1. System structure function diagram.](image1)

The purpose of this design is to design a precise irrigation system that is timely, easy to use, simple, flexible and low cost. Compared with other wireless networks such as GPRS, ZigBee also has the advantage of low cost. A remote innovation created as an open worldwide norm to address the special necessities of minimal expense, low-power remote IoT organisation is termed as Zigbee technology. Based on IEEE 802.15, the working process is taken. The convention permits gadgets to convey in an assortment of organisation geographies in addition to can have battery life enduring quite a long while. It is a principle-based remote innovation created to empower minimal expense, low-power remote machine-to-machine (M2M) as well as web of things (IoT) organisations. It is for low-information rate, low-power applications then are an open norm. Therefore, it is a feasible solution to apply ZigBee technology to this system. Figure 2 shows the block diagram of the design scheme that comprehensively considers the characteristics of ZigBee and the needs of precision irrigation.

This design mainly consists of terminal control nodes, routing nodes and coordinator nodes. The terminal node is composed of sensing equipment and solenoid valves. The routing node is mainly attached to the terminal node and is responsible for routing and forwarding the information collected by the sensing equipment in the terminal node. The

![Figure 2. The block diagram of the design scheme.](image2)
The coordinator node mainly accepts the information forwarded by each routing node and uploads it to the host computer. In addition, the network formation and parameter configuration are also completed by the coordinator node, and when the network is formed, the coordinator node will be added to the routing and the procession of forwarding data packets acts as a router. At this time, it will periodically upload the collected moisture information to the host computer and send heartbeat packets. The purpose of sending heartbeat packets is to monitor whether the host computer is connected properly and to detect the current network quality. After the upper computer receives the moisture information, it will store it in the database to form historical data, and calculate the irrigation amount of the plant based on the number of opening and closing of the valve. In addition to automatic control, the host computer is also set to manual mode. For example, in some special periods such as pesticide application, you can manually control the irrigation time and frequency. The entire design is powered by solar photovoltaic panels and lead-acid batteries.

The electrical structure schematic diagram of this portable open channel flow monitoring device is shown in Figure 3.

The pressure difference sensor mainly collects the pressure difference signal generated by the difference in the water column rise of the corresponding flow channel, that is, the dynamic pressure and the static pressure measuring flow channel on the device. A pressing factor sensor works through changing over pressure into a simple electrical sign. The interest for pressure estimating instruments expanded throughout the steam age. These days we measure pressure electronically utilising pressure transducers as well as pressing factor switches. The analog signal is processed by the multi-channel gating detection circuit and transmitted to the microprocessor. The multichannel locator is separated into various flat strips, relating towards the yield from every fibre. Thus, various spectra can be estimated at the same time. Intended to detect smoke, heat or potentially CO, multi-sensor indicators assist with diminishing bogus alerts through looking at the contributions from the numerous sensors before choosing whether the wellspring of the info is a genuine fire else one among numerous bogus caution conditions. On the one hand, the on-site portable display channel flow value $Q$ and water level value $h$ can be displayed through the built-in liquid crystal display; on the other hand, it can be uploaded to the cloud platform through the serial port and the LORA gateway, and the software interface designed on the host computer can be displayed in real time. The open channel parameters are real-time values of flow velocity, water level and flow. The data in the detection process can be stored and displayed on the IoT cloud platform for the call and analysis of water conservancy workers. The automatic monitoring system that can realise the real-time monitoring of the open channel in the irrigation area not only lies in the construction of the hardware system; it also requires the coordination of the software system, which requires a large number of on-site debugging and measurement in the later stage.

Essentially, a pitot tube is utilised in air stream tests as well as on planes to gauge stream speed. It is a thin cylinder that has two openings on it. The front opening is put in the airstream towards gauge what's known as the stagnation pressure. The side opening estimates the static pressing factor. This experimental device is a self-made cuboid flow measurement device based on the Pitot tube principle. The device structure diagram is shown in Figure 4 and Figure 5.

A counterfeit channel that is built to convey water towards the fields to accomplish water system is alluded as canal water irrigation system. The water is taken either from the waterway, tank else repositories. The trenches can be developed either through concrete,
irrigation area depends on the actual conditions of the water inflow from the head of the canal and the water demand for irrigation. When the actual amount of water diversion at the head of the canal is greater than the water demand for irrigation, water distribution on demand will be implemented. However, when the amount of water diversion at the head of the canal is less than the water demand for irrigation, it is usually implemented proportionally or optimised. Water distribution on demand refers to the implementation of adequate water supply according to the water requirements of crops. Proportional allocation of water refers to the allocation of water in proportion to the amount of water used for irrigation, the area of irrigation or the amount of labour invested in the original construction of the water conservancy project. Irrigation canal water allocation is composed of three modules: calculation of irrigation water demand for certain irrigation, calculation of water inflow from canal head and canal water distribution.

Whether crops need to be irrigated is determined by soil moisture, and the optimal growth conditions of crops can be used as a basis for whether to irrigate the farmland. This requires the intelligent analysis module to predict whether the farmland needs to be irrigated at the next moment according to the collected data values. This paper adopts the method of time series prediction to build the soil moisture prediction model, and the specific requirements are as follows: (1) It needs to display the soil moisture information collected by the terminal device on the same coordinate axis to obtain a time series. (2) It needs to analyse the obtained time series, analyse whether it is relevant, and obtain the correlation function of the time series. In the process of analysis, individual unreliable data is eliminated, for example, if a certain data is abrupt, it will be eliminated. At the same time, the system will automatically determine whether the data is abnormal, and all abnormal collection points will be replaced with expected values. (3) There are many kinds of time series, and the system should work out corresponding forecasting schemes according to different time series. The stable time series can be predicted by the ARMA model, and the non-stationary time series needs to be converted into a stationary series and then predicted. In the factual investigation of time series, autoregressive–moving-normal (ARMA) models give a tightfisted portrayal of a (feebly) fixed stochastic cycle as far as two polynomials, one for the autoregression (AR) in addition the second for the moving normal (MA). The calculation process of irrigation water demand is shown in Figure 6.

The calculation of irrigation water demand is initiated with soil moisture meteorological information.
It is further divided into two sections named as reference crop evapotranspiration and estimated value of irrigation quota. In reference crop section, the crop water demand has been calculated based on taking the reference crops. Then, actual crop evapotranspiration process is done to get the crop water requirement. The estimation of irrigation quota is calculated based on the product of irrigation quota and irrigation region. Finally, irrigation quota as well as crop water requirement are combined to the requirement of irrigation water. To calculate the irrigation water demand, you must first calculate the crop water demand. There are two types: one is to calculate the total water demand for the whole growth period. There are many calculation methods for the crop water demand. It can be divided and then based on the water demand film coefficient of each stage. The allocation is made to determine the available water volume to determine the water diversion task index of each management station.

Guided by advanced technology and forward-looking concepts, we will make full use of science and technology including Internet of Things technology and 3S technology to set up a complete set of intelligence with pollution incident emergency response, environmental level analysis, environmental supervision, alarm system and early warning station Online monitoring system. A significant part in satellite film law implementation as well as investigation is said to be as 3s innovation. Top-quality picture maps obtained through RS in various periods are the premise of satellite film law requirement. GPS can precisely find dynamic patches. An association’s current circumstance comprises of two sections: (a) the large-scale ecological measurements, e.g. financial, social, mechanical, worldwide and political; besides (b) the miniature climate. The cycle comprises (i) Scanning, (ii) Monitoring, (iii) Forecasting and (iv) Assessment. Real-time data monitoring of the water environment system greatly improves our ability to deal with emergencies in the water environment, strengthen and improve our ability to govern the water environment, and provide strong technical support for the government’s water environment development and governance. By investigating the development of my country’s water environment and the impact of
pollution on the entire environment, using science and technology that combines space and practice, the entire system framework for online water environment monitoring has been constructed. The entire information monitoring system uses GPRS technology to establish and comprehensively detect the information of the detection points, and send the detected data information to the entire control centre server, which is used to optimise the update and refresh of the data information in the entire database; RS technology is used to obtain three-dimensional image information of the entire water environment, use the established water quality monitoring model to simulate it as a whole and obtain the change trend of its water environment, and make early prevention of other emergencies; use GIS to obtain the overall system The storage of spatial data, the three-dimensional analysis of the model results and the visual display of the results.

The overall system architecture is shown in Figure 7. This article regards the water environment safety management of the river basin as the goal and takes the investigation of the pollution source status of the river basin and the analysis of the water environment safety status as the basis to achieve the goal of guaranteeing the water environment safety of the river basin. By analysing and summarising the latest research progress in realising water environment monitoring automation and informatisation at home and abroad, this paper makes full use of its experience to investigate water environment monitoring information, and combines the actual situation to research and develop the water environment online monitoring system. Moreover, this paper combines science and technology including Internet of Things technology and 3S technology to design a set of online water environment monitoring system that is both scientifically advanced and practical. The design and implementation of this system will be able to safely, timely and effectively monitor the water quality of the water environment in real time, and upload the abundant water environment monitoring data to the testing centre for processing and storage. In addition, it can truly and effectively reflect the actual situation of the water environment and provide a rich data information foundation for the water environment management department of the national government to promote the sustainable and rapid development of China’s society, economy, and environmental protection.

**System test**

After combining the Internet of Things and data analysis to construct an agricultural water management system, the performance verification of the system constructed in this paper is carried out. The performance of the system constructed in this paper is analysed through design experiments. First, the data monitoring effect of the agricultural water management system constructed in this paper is verified. The results are shown in Table 1 and Figure 8. Based on the combination of Internet of Things as well as data analysis to build an agricultural water management system, the data are taken. By using the design experiments, the accomplishment of the system is verified. Table 1 shows the statistical results of data monitoring effect and Figure 8 depicts the graphical representation of data monitoring effect for knowing the results in a pictorial representation. The interaction of proactively assessing as well as assessing your information is said to be as data monitoring. Its quality guarantees that it is good for reason. It assists you with estimating besides track your information utilising dashboards, cautions and reports. Checking not just gives more information in addition to a superior comprehension of task elements, which thus can assist with further developing plan, yet can likewise further develop cycles then results, specifically for the most un-locked in.
Depending on Internet of Things and data analysis, the agricultural water data monitoring effect is built, and then the numerical outcomes as well as the graphical representation are given in Table 1 and Figure 8 shows the efficiency of the proposed method is good. On this basis, this paper evaluates the effectiveness of the system’s agricultural water management, and the results are shown in Table 2 and Figure 9. Table 2 shows the statistical results of agricultural management effect and Figure 9 depicts the graphical representation of agricultural management effect for knowing the results in a pictorial representation. It additionally helps in the comprehension of plant water use, including its effectiveness, evaluating crop happening as permitting ranchers towards devise methodologies to further develop crop creation, diminishing useless water misfortunes and limiting area then water corruption.

Through the above research, we can see that the agricultural water management system based on the Internet of Things and data analysis constructed in this paper has good agricultural water management effects.

### Conclusion

In the design of the agricultural water management system based on the Internet of Things and data analysis, this paper studies the overall advantages of the ZigBee network system and the advantages of ZigBee

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**Table 1. Statistical table of data monitoring effect.**

| No. | Data monitoring | No. | Data monitoring | No. | Data monitoring |
|-----|-----------------|-----|-----------------|-----|-----------------|
| 1   | 94.7            | 27  | 98.0            | 53  | 97.2            |
| 2   | 96.9            | 28  | 95.1            | 54  | 94.5            |
| 3   | 94.6            | 29  | 95.7            | 55  | 94.2            |
| 4   | 97.4            | 30  | 95.2            | 56  | 95.8            |
| 5   | 94.8            | 31  | 97.6            | 57  | 94.7            |
| 6   | 94.9            | 32  | 96.3            | 58  | 97.7            |
| 7   | 95.7            | 33  | 97.5            | 59  | 95.9            |
| 8   | 97.5            | 34  | 95.6            | 60  | 94.1            |
| 9   | 95.8            | 35  | 95.2            | 61  | 97.3            |
| 10  | 94.1            | 36  | 95.0            | 62  | 94.8            |
| 11  | 96.4            | 37  | 95.6            | 63  | 96.9            |
| 12  | 97.1            | 38  | 94.5            | 64  | 96.4            |
| 13  | 97.2            | 39  | 95.5            | 65  | 96.1            |
| 14  | 95.9            | 40  | 95.6            | 66  | 97.5            |
| 15  | 95.6            | 41  | 96.8            | 67  | 97.4            |
| 16  | 97.0            | 42  | 96.7            | 68  | 94.2            |
| 17  | 94.1            | 43  | 96.1            | 69  | 94.8            |
| 18  | 94.8            | 44  | 95.6            | 70  | 95.0            |
| 19  | 95.1            | 45  | 94.6            | 71  | 94.5            |
| 20  | 97.1            | 46  | 96.4            | 72  | 94.6            |
| 21  | 94.7            | 47  | 96.9            | 73  | 96.2            |
| 22  | 96.5            | 48  | 95.2            | 74  | 98.0            |
| 23  | 94.0            | 49  | 96.3            | 75  | 97.8            |
| 24  | 97.3            | 50  | 96.4            | 76  | 95.0            |
| 25  | 96.8            | 51  | 97.9            | 77  | 97.1            |
| 26  | 95.6            | 52  | 94.7            | 78  | 94.1            |

**Figure 8. Statistical diagram of data monitoring effect.**
in the water environment monitoring system by studying the basic theories of the Internet of Things technology, which provides effective theoretical ideas for the construction of the system. Moreover, this paper designs and studies the optimisation and integration technology of the water environment monitoring network system, in-depth study of intelligent control theory, and introduces the specific application of time series forecasting model in farmland irrigation system, including the modelling of soil moisture forecasting model and the modelling of irrigation water consumption forecasting model. After that, this paper designs the software and hardware of the ZigBee wireless sensor network monitoring node, including the circuit design of the hardware circuit of the ZigBee network monitoring node and the design of the software acquisition program, to realise the data collection and short-distance transmission of the farmland environment. Finally, the design test in this paper verifies the performance of the system designed in this paper. From the research point of view, it can be known that the system designed in this paper basically meets the needs of agricultural water management.

Table 2. Statistical table of agricultural water management effect.

| No. | Agricultural water management | No. | Agricultural water management | No. | Agricultural water management |
|-----|-------------------------------|-----|-------------------------------|-----|-------------------------------|
| 1   | 87.8                          | 27  | 94.3                          | 53  | 92.8                          |
| 2   | 94.8                          | 28  | 94.4                          | 54  | 91.4                          |
| 3   | 89.9                          | 29  | 89.0                          | 55  | 89.4                          |
| 4   | 92.1                          | 30  | 94.4                          | 56  | 93.7                          |
| 5   | 87.5                          | 31  | 89.4                          | 57  | 89.8                          |
| 6   | 91.5                          | 32  | 94.7                          | 58  | 90.7                          |
| 7   | 90.4                          | 33  | 91.0                          | 59  | 89.6                          |
| 8   | 94.1                          | 34  | 92.5                          | 60  | 89.0                          |
| 9   | 90.0                          | 35  | 92.4                          | 61  | 87.6                          |
| 10  | 88.4                          | 36  | 92.7                          | 62  | 90.0                          |
| 11  | 87.8                          | 37  | 92.4                          | 63  | 92.1                          |
| 12  | 90.7                          | 38  | 92.8                          | 64  | 91.2                          |
| 13  | 94.6                          | 39  | 87.7                          | 65  | 87.7                          |
| 14  | 87.7                          | 40  | 90.2                          | 66  | 89.8                          |
| 15  | 89.0                          | 41  | 91.3                          | 67  | 94.8                          |
| 16  | 87.1                          | 42  | 90.6                          | 68  | 87.1                          |
| 17  | 87.6                          | 43  | 88.6                          | 69  | 87.7                          |
| 18  | 92.6                          | 44  | 92.5                          | 70  | 91.5                          |
| 19  | 91.6                          | 45  | 91.1                          | 71  | 88.5                          |
| 20  | 87.1                          | 46  | 87.5                          | 72  | 89.3                          |
| 21  | 91.2                          | 47  | 93.7                          | 73  | 94.3                          |
| 22  | 93.8                          | 48  | 93.0                          | 74  | 93.8                          |
| 23  | 91.3                          | 49  | 91.1                          | 75  | 90.1                          |
| 24  | 91.6                          | 50  | 87.6                          | 76  | 93.8                          |
| 25  | 93.5                          | 51  | 91.1                          | 77  | 90.3                          |
| 26  | 93.3                          | 52  | 92.6                          | 78  | 94.4                          |

Figure 9. Statistical diagram of agricultural water management effect.
**Disclosure statement**

No potential conflict of interest was reported by the author(s).

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