Internet of Things Technology in Monitoring System of Sustainable Use of Soil and Land Resources

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ABSTRACT With the development of global economy, the sustainable use of land resources has become a key research topic in the current social and economic development. To do a good job in the sustainable use of land resources can solve such problems as waste of land resources, quality degradation, environmental damage, ecological imbalance and so on. How to realize the sustainable utilization of resources, the first thing to be solved is the sustainable monitoring of land resources. At present, many researches have been done in this field at home and abroad, but in conclusion, there are some problems, that is, the basic theory is not deep and the practical application is less. Therefore, this paper will study the application of the monitoring system of the sustainable use of soil and land resources under the support of the Internet of things big data technology, and establish a practical monitoring system of the sustainable use of land resources. The monitoring system in this paper makes full use of modern science and technology. On the basis of intelligent technology, combined with the actual situation of land resources in China, according to the practical problems, the construction principles of evaluation index system and index construction are established. In the aspect of monitoring system construction, we have greatly optimized the traditional construction method, which makes the system in this paper have better adaptability, scalability and accuracy. In order to further verify the reliability of the system, this paper carries out the performance test, accuracy test, and monitoring test in extremely harsh environment. Finally, the data show that the system can be applied to most of the land environment to monitor the sustainability of land resources.

INDEX TERMS Internet of Things Technology, land resources, sustainable utilization, Internet of Things monitoring system.

I. INTRODUCTION

Land resources are the non-renewable resources on which human society depends for survival and development. How to make better use of land resources and realize sustainable utilization is a major issue that deserves the common concern of all mankind. Since the beginning of the 21st century, with the increasingly severe global population growth and the pursuit of rapid economic development, the way of human land use has been changing, this will directly affect the change of resources, economy and ecological environment. Land has always been an important contribution to human economic and social development. With the continuous progress of science and technology and productivity, human society has ushered in unprecedented opportunities for development. Along with the opportunity comes the more severe challenge, which comes from a series of problems such as excessive consumption of resources, vegetation destruction, land quality degradation, environmental pollution, ecological deterioration, natural disasters, species extinction and so on. Today, sustainable development has become the direction of common development for all mankind. The sustainable use
of land is one of the essential conditions and core contents to realize the sustainable development of human society and economy. Sustainable land use will play an important role in promoting sustainable economic and social development.

It is generally believed that the research on sustainable land use in the world mainly comes from land suitability evaluation. Its emergence and development in the past 20 years, especially in the 1990s, the rapid development of sustainable land use index system and evaluation research plays a very important role. In 1993, FAO officially published the evaluation outline of sustainable land use management, which stipulates the basic principles, procedures and five evaluation principles of sustainable land use management, and puts forward the natural, economic and social evaluation indicators of sustainable land use management. Compared with foreign countries, Chinese scholars pay more attention to study of regional indicators sustainable land use. In the book “theory and practice of sustainable land use management”, Zhang Fengrong comprehensively introduced the principles of sustainable land use management of FAO, and analyzed and evaluated the typical land use system in China. Some scholars have discussed the evaluation indexes and methods of land sustainable use, put forward the evaluation framework, and made a detailed study on the evaluation indexes of land sustainable use system. At present, although the domestic research involves a wide range, it has the characteristics of “the middle way”, that is, the basic theory is not deep and the practical application is less. Therefore, there are some problems in both theory and practical application, especially there is no research case of perfect combination of basic theory and practice [1], [2].

In order to better combine theory and practice, this paper will take this as the research purpose, under the support of the Internet of things big data technology, carry out the application research in the monitoring system of the sustainable use of soil and land resources. The research direction of this project is to establish a set of intelligent monitoring system for sustainable use of land resources through the modern intelligent technology, that is, the interactive information advantage of the Internet of things. Before the establishment of the system, this paper establishes the index system of sustainable use of land resources, and makes a comprehensive evaluation from six aspects of scientificity and operability, comprehensiveness and hierarchy, system dominance, and regionality, so as to ensure that the research results are more comprehensive, scientific and accurate. In the overall design of the monitoring system of the Internet of things, this paper compares and analyzes some traditional methods, and finally selects armcortex-a53 as the processor of the monitoring system, using the combination of hardware and software to realize the data processing, including encoding and decoding and data transmission. In the hardware selection method, this paper uses raspberry pie as the hardware core of this study, which makes the system has a good scalability, and greatly improves the accuracy and operability. The optimized monitoring system can run perfectly in all kinds of environments, even in the extreme harsh environment can also ensure high-precision monitoring. After a number of experiments in this paper, through data we believe that the Internet of things land resources sustainable monitoring system studied in this paper is an innovative technology that can be used and practiced, and it is worthy of extensive promotion and in-depth study [3], [4].

II. OVERVIEW OF BASIC THEORY
A. SUSTAINABLE USE OF LAND RESOURCES

Land resource utilization is the product of interaction, common development and continuous evolution between human society and nature, which directly affects the ecological environment of land resources. Therefore, the sustainable and reasonable use of land resources is the premise of its sustainable development and the key to the healthy development of economy and society. The sustainable utilization of land resources involves many factors such as resource conditions, environmental conditions, economic level and social development. In theoretical research and practice of sustainable use of land resources, due to different level of regional development, the research focus is also different, and connotation of sustainable use of land resources is also different. But generally speaking, the sustainable use of land resources refers to the coordinated development and management of land relations through rational development, which means that land resources can not only meet the living needs of contemporary people, but also not affect the survival needs of future generations in a specific regional scope and development stage.

Its basic connotation includes the following aspects: (1) from the ecological point of view, the sustainable use of land resources must ensure the basic ecological maintenance of the required resource stock, the stability or sustainable growth of land resource productivity, and the stability of land resource living environment. At the same time, we should make sure that the land use mode is suitable for its suitability, maintain the potential of land resources, and protect the sustainable development of resources and environment. (2) From the perspective of social economy, the sustainable use of land resources should meet the sustainable development of regional economy and society on the basis of effective protection and improvement of ecological environment, and ensure the stability of land system structure. (3) From the ethical point of view, the sustainable use of land resources should reflect intergenerational equity. Land resources should not only protect the needs of contemporary people, but also take into account the needs of future generations [5], [6].

B. INTERNET OF THINGS TECHNOLOGY

Internet of things technology is the abbreviation of Internet of things. Internet of things is a kind of network which can realize the mutual connection between ordinary objects and independent functions. The Internet of things uses a variety of sensing devices, combined with different communication
methods, to connect things and things to the Internet, to realize the automation and intelligence of information collection, transmission and processing, and to achieve the purpose of scientific management anywhere, anytime. The Internet of things realizes the intelligent interconnection among things, people and people. The Internet of things is generally divided into three layers: perception layer, transmission layer and application layer.

1) PERCEPTION LAYER
The sensing layer, also known as “DEVICE LAYER”, consists of sensing objects and sensor devices. This layer is mainly responsible for processing the specific important data information of the acquisition object identified by the sensor equipment, and converting these information into digital signals, so that it can be safely transmitted to the information processing system.

2) TRANSPORT LAYER
The transmission layer is called the neural system of the Internet of things, which is responsible for transmitting the information obtained by the sensing layer to the processing center through various networks for processing. The transport layer is based on communication network and Internet. Through the comprehensive utilization of wired transmission and wireless transmission, the two-way transmission, routing and control of sensor layer data and control information are realized, and data-centric storage, query, mining, decision-making and analysis are realized.

3) APPLICATION LAYER
The application layer is the top layer of the Internet of things architecture. It provides global management of data applications and develops various applications for the Internet of things. The application of Internet of things can be divided into four types: scanning type, query type, control type and monitoring type. Scanning applications such as mobile wallet, query applications such as remote meter reading, intelligent retrieval, smart home and intelligent transportation are control applications, while environmental pollution monitoring is monitoring application [7]–[9].

C. CONSTRUCTION PRINCIPLES OF EVALUATION INDEX SYSTEM
The ultimate purpose of sustainable utilization of land resources is to lay a solid resource foundation for improving the comprehensive benefits of ecology, economy and society. The evaluation of sustainable use of land resources needs a perfect index system, and the selected indexes should reflect the changes of research objectives at different levels. Therefore, in order to make the evaluation results more comprehensive, scientific and accurate, the following principles should be followed when establishing the index system:

1) SCIENTIFICITY AND OPERABILITY
The establishment of index system must follow the principle of land sustainable utilization and be based on the theory of land resources sustainable utilization. It is necessary to consider the difficulty of data collection and the authenticity of data to establish the index system. Only on the basis of comprehensive consideration of various subjective and objective factors can the index system be operable.

2) COMPREHENSIVE AND HIERARCHICAL
The selection of indicators should focus on comprehensiveness, including productivity, production stability, economic feasibility, resource protection and social acceptability. The sustainable evaluation of land resources is a complex system, including many subsystems. Therefore, the selected indicators should be hierarchical and can reasonably reflect the problems.

3) DOMINANCE OF THE SYSTEM
The sustainable use of land resources is the systematic goal of all kinds of land resources utilization. Therefore, its evaluation purpose lies in the comprehensive evaluation system of land utilization. That is to say, when establishing the comprehensive evaluation index system, we should comprehensively consider the evaluation index of resources, economy and society, and pay attention to the importance of each index in the whole evaluation system and its mutual influence relationship.

4) AREA
Different regions have different evaluation focuses on the sustainable use of land resources. It is necessary to change the selection of the corresponding evaluation indexes and methods according to the actual situation. In other words, the evaluation of sustainable land use should follow the regional principle.

5) DYNAMIC REAL TIME
The selected evaluation factors of sustainable use of regional land resources should not only have relatively stable evaluation indicators, but also dynamic and real-time evaluation factors, so as to accurately reflect the relatively stable factors and the results of the evaluation of sustainable use of land resources with dynamic development trend, and provide a more scientific and reasonable basis for land use management.

6) COMBINATION OF OBJECTIVITY, PREDICTABILITY AND SENSITIVITY
Scientific and reasonable evaluation index should have the following characteristics: first, it can objectively reflect the current situation and characteristics of regional land use, and provide objective factual basis for the whole evaluation system. Second, it can be predicted that the impact or consequences of indicators on land use can be predicted through
scientific and technological analysis, which can always be reflected in specific evaluation. Third, it is not only sensitive to changes in time and space, but also to changes in surrounding factors [10]–[13].

III. CONSTRUCTION METHOD OF LAND RESOURCES SUSTAINABLE MONITORING SYSTEM

A. ESTABLISHMENT OF INDEX SYSTEM

Scientific and reasonable index selection is the basis of the evaluation of the sustainable use of land resources. The selection of indicator system is based on reality, following the principle of systematization, scientificity, comparability, operability and regionality. It refers to the evaluation of the five objectives of land sustainable use evaluation. The outline of sustainable land use management is listed by a series of related evaluation indicators [14]–[16] published by FAO in 1993, including productivity, production stability, economic feasibility, resource protection and social acceptability. Combined with the actual situation of land use and the characteristics of sustainable land use in China, and referring to the evaluation standards of sustainable land use at home and abroad, the overall goal of sustainable land use and sustainable land use of the evaluation system is to finally establish, as shown in Table 1:

| Criteria layer          | Indicator Code | Index layer                        |
|------------------------|----------------|------------------------------------|
| Productivity B1        | C1             | Land productivity                  |
|                        | C2             | Grain yield per hectare            |
|                        | C3             | Forest stock                       |
|                        | C4             | Effective irrigation area          |
| Production stability B2| C5             | Soil erosion area                  |
|                        | C6             | Affected area                      |
|                        | C7             | GDP per capita                     |
| Economic feasibility B3| C8             | Proportion of agriculture in GDP   |
|                        | C9             | Engel coefficient of rural residents |
|                        | C10            | Per capita public green area       |
|                        | C11            | Per capita cultivated land area    |
| Resource conservation B4| C12         | Application amount of chemical fertilizer |
|                        | C13            | natural population growth rate     |
| Social acceptability B5| C14            | Rural per capita housing area      |
|                        | C15            | Urbanization rate                  |

B. OVERALL DESIGN OF INTELLIGENT MONITORING SYSTEM

At the same time, various types of sensors are connected to the real-time monitoring site where the physical parameters (such as temperature, humidity, etc.) can be monitored by the intelligent gateway. Then the video is encoded through the intelligent gateway, and then the encoded video data and collected data are transmitted through the wireless or wired network through the sensor Internet of things cloud platform, Users can obtain the situation of monitoring sites from the Internet of things cloud platform through mobile devices such as mobile phones. On this basis, the intelligent gateway can identify and analyze the dynamic targets on the monitoring site through computer vision and other related technologies, and realize intelligent monitoring functions such as motion detection, independent alarm [17]–[19].

C. TREATMENT SCHEME SELECTION

At present, most of the mainstream processing schemes are arm and DSP chips. Table 2 summarizes the advantages and disadvantages of several current video processing schemes.

As can be seen from Table 1, the first scheme uses dsp to process data, which is fast, but does not support the operating system, and has poor modifiability and scalability; the second scheme uses dsp to compress data, and uses arm operating system to support application, which has strong image processing ability, but high cost, and it is difficult to debug synchronously between arm and DSP, so it is difficult to develop; Compared with the former three schemes, the fourth scheme uses ffmpeg coding and decoding module to complete data compression, which can support the development of multiple data formats, easy to maintain, strong scalability and low cost. Considering that the four schemes adopt the combination of
TABLE 2. Monitoring treatment plan.

| Treatment plan          | Advantage                        | Shortcoming                      |
|------------------------|----------------------------------|----------------------------------|
| 1 DSP + camera         | Fast processing speed            | No operating system, poor        |
|                        |                                  | expansibility                    |                                   |
| 2 DSP+ARM              | Support operating system, strong | Difficult to develop, high       |
|                        | computing power                  | cost                              |                                   |
| 3 Arm + camera + hardware codec module | Fast, operating system available | High cost                        |                                   |
| 4 Arm + camera + software and hardware combination coding | Complete system, strong expansibility and fast operation | CPU computing power determines image processing power |   |

software and hardware to realize data processing, including encoding, decoding and data transmission [20]–[22].

D. OVERALL DESIGN OF INTELLIGENT MONITORING SYSTEM

This design selects the raspberry pie 3B as the core of the hardware platform. Raspberry pie is only the size of a card, but it has all the functions of a PC. The development board has four USB interfaces, which can be connected with peripheral devices. After the development, the module can quickly realize network data transmission. Raspberry pie has many interfaces, which are very suitable for design and can quickly complete the development of monitoring system [23], [24].

E. SELECTION OF ACQUISITION EQUIPMENT

The official camera of raspberry sect is selected as the video acquisition equipment of the system. Raspberry camera is small, only 20 * 25 * lomm, and supports 1080p / 30fps video recording at most. It is easy to install and can be inserted directly into the raspberry pie plate on the CSI camera interface. The image processing process is described below.

The image data collected by the camera is sent to the unicorn component of GPU through CSI interface sent by raspberry, and then the collected dynamic video image is processed by digital image processor; if the final image format required by the application program is RGB, YUV and other data that does not need to be encoded, ISP will convert the video frame into this format, and then send the image frame to CPU through DMA; If the video format required by the application is H.264, for MPEG and other encoding formats, the corresponding encoding module needs to encode the image data and send the processed data to the CPU through DMA [25], [26].

F. MODEL SELECTION OF ALARM MODULE

GSM alarm module is added to the system in this paper, which is used to alarm when the system is abnormal. In case of abnormal intrusion on the monitoring site, the system can inform the monitoring personnel of the alarm situation through SMS.

GSM is developed by ETSI. The cost of GSM short message is low, flexible, convenient, stable and reliable, so using GSM short message to realize alarm and remote control is a good solution. GSM module integrates the basic functions of mobile phone, such as calling and sending SMS, into a small circuit board, which has a wide range of applications. This design adopts sim800cgprs / GSM module [27].

G. SENSOR SELECTION

In this section, the selection of sensors in this system is described.

1) DHT11 temperature and humidity sensor is selected. It has temperature measuring element and resistance humidity sensing element, which can measure humidity while measuring temperature. The output signal is calibrated to improve reliability. In the process of measurement, the result should be calculated according to the calibration coefficient. DHT11 sensor uses 3.3-5v DC power supply, the temperature and humidity range is 0-50 °C and 20-90% RH respectively, and the measurement accuracy is ±2 °C and ±5% RH respectively.

2) Gas sensor

In the system, mq2 sensor is selected to monitor the gas information such as smoke and combustible gas. Mq2 smoke sensor can be used as a gas monitoring device to detect liquefied gas, benzene, alcohol, smoke and other gases. The mq2 smoke sensor is a gas sensor. When the surface of SnO2 is heated to 200-300 °C, it can absorb the negative ion oxygen in the air. Therefore, the electronic density of the surface is reduced and the resistance is increased. The heating voltage of mq2 is 5 ± 0.2V. Care should be taken to avoid scratching the equipment.

H. SELECTION OF SOUND ALARM MODULE

When the system detects the illegal intrusion, it will drive the alarm module to give an audible warning, and send a short message through the GSM module. Connect the buzzer to
realize the alarm function. Working voltage 3.3-5v, connect GPIO pins 1 and 2. [28].

### IV. RELIABILITY TEST OF MONITORING SYSTEM

The test of the system is mainly carried out in the mountainous area of Hefei city. The probe of soil temperature and humidity sensor is inserted into the soil near the tree, the depth is about 5cm, and the gas sensor and other equipment are fixed on the tree.

#### A. PERFORMANCE TESTING

The performance test of the system is mainly the stability test of the system, the purpose is to test whether the system can operate normally. Set the collection time interval of the monitoring system to 30 minutes and send it to the recipient’s mobile number. The receiver reads the data and stores it. As shown in Table 3, it is the measured value of temperature and humidity data of a certain day. At 14:30, the humidity increased greatly due to watering. The temperature and humidity change curve is shown in Figure 1. It can be seen that the system can run stably for a long time, and the change trend of the measured temperature and humidity value is basically consistent with the actual situation.

#### B. ACCURACY TEST

The accuracy of the system is verified by comparing with the temperature and humidity value measured by hand. Set and turn on the air temperature and humidity meter, and set the soil temperature and humidity meter to display the reading in the soil. At the same time, manually record the data of each measuring instrument. Tables 4 to 7 show the numerical comparison between the automatic measurement results and the manual measurement results at different times. Each data is the average of four consecutive sets of measurements. The data collected by the monitoring system can be accurate to two decimal places, but the temperature value measured manually can only be accurate to one decimal place, and the humidity value can only be accurate to the whole place. In order to facilitate comparison, the number of data collected by the monitoring system is exactly the same as the number of manually measured values.

According to the relevant data in Table 4-7 and Figure 2, the following analysis is obtained:

#### TABLE 3. Temperature and humidity monitoring results.

| Time | Test number | Soil temperature (°C) | Soil moisture (%) | Air temperature (°C) | Air humidity (%) |
|------|-------------|-----------------------|-------------------|----------------------|-----------------|
| 12:30 | 1           | 15.65                 | 15.64             | 15.89                | 28.11           |
| 13:00 | 2           | 15.77                 | 16.42             | 16.23                | 28.93           |
| 13:30 | 3           | 16.27                 | 13.66             | 16.74                | 30.22           |
| 14:00 | 4           | 16.86                 | 13.57             | 16.33                | 30.69           |
| 14:30 | 5           | 15.27                 | 73.87             | 17.48                | 30.35           |
| 15:00 | 6           | 16.19                 | 69.01             | 17.99                | 29.75           |
| 15:30 | 7           | 16.51                 | 65.43             | 19.68                | 27.69           |
| 16:00 | 8           | 16.69                 | 64.71             | 21.57                | 27.82           |
| 16:30 | 9           | 16.38                 | 62.32             | 19.03                | 27.14           |

#### FIGURE 1. Temperature and humidity monitoring results.

#### TABLE 4. Air temperature monitoring data.

| Test number | Manual measurement value (°C) | System measured value (°C) | Relative error (%) |
|-------------|--------------------------------|-----------------------------|--------------------|
| 1           | 17.8                           | 17.9                        | 0.52               |
| 2           | 17.1                           | 16.7                        | 2.11               |
| 3           | 15.9                           | 16.1                        | 1.17               |
| 4           | 14.7                           | 14.9                        | 1.89               |
Table 4 and Table 5 are manual systems for air temperature and air humidity measurement. The relative error of air temperature is less than 2.5%, the maximum relative error of air humidity is 7.21%, and the corresponding humidity difference (absolute error) is 1.5% within the acceptable range, indicating that the accuracy of the system is relatively high. In addition, since the result of automatic measurement is from two decimal places to one decimal place or integer, the relative error will also be affected. Table 6 and Table 7 record the soil temperature and humidity data. The relative error is less than 3.5% of the acceptable range of the system. In addition, when measuring the soil temperature and humidity, the probe is inserted into the soil at different depth and in different ways, which may lead to errors between the measured values. In conclusion, the monitoring system has high stability and reliability.

### TABLE 5. Soil temperature monitoring data.

| Test number | Manual measurement value (°C) | System measured value (°C) | Relative error (%) |
|-------------|--------------------------------|---------------------------|-------------------|
| 1           | 26                             | 28                        | 7.21              |
| 2           | 28                             | 29                        | 3.17              |
| 3           | 28                             | 29                        | 3.28              |
| 4           | 29                             | 29                        | 0.00              |

### TABLE 6. Soil moisture monitoring data.

| Test number | Manual measurement value (%) | System measured value (%) | Relative error (%) |
|-------------|------------------------------|---------------------------|-------------------|
| 1           | 57                           | 56                        | 1.81              |
| 2           | 49                           | 47                        | 2.42              |
| 3           | 50                           | 51                        | 1.33              |
| 4           | 50                           | 49                        | 1.18              |

Table 8 and Figure 3 analyze the test data. Although the data value of temperature and humidity measurement is relatively accurate, there are still some fluctuations, but the amplitude of the fluctuation does not exceed the accuracy range of the sensor, indicating that there are some interference factors between the sensor and the measured data transferred to the data of the single chip microcomputer, resulting in the error in the data measurement results. Each process of data transmission may be interfered by different factors, but the total error value is acceptable.

### FIGURE 3. Analysis of soil and air temperature and humidity monitoring data.

#### C. ACCURACY TEST

In order to improve the accuracy, this paper has carried on the accuracy test. Error analysis and calibration are carried out. As shown in Table 8 and Figure 3, a set of data values of temperature and humidity parameters of air and soil are measured at the same time.

As can be seen from Table 8 and Figure 3, although the data value of temperature and humidity measurement is relatively accurate, there are still some fluctuations, but the amplitude of the fluctuation does not exceed the accuracy range of the sensor, indicating that there are some interference factors between the sensor and the measured data transferred to the data of the single chip microcomputer, resulting in the error in the data measurement results. Each process of data transmission may be interfered by different factors, but the total error value is acceptable.

### D. TEMPERATURE AND HUMIDITY TEST OF MONITORING SYSTEM IN BAD ENVIRONMENT

Considering the climate conditions of hot summer and cold winter, the system was tested with ice and boiled water at low and high temperature respectively. Insert the soil temperature and humidity sensor into the soil covered with ice and snow, insert the ice air temperature and humidity sensor into the soil to pour hot water, insert the air temperature and humidity sensor into the soil, the system works normally, and the measurement data are shown in Table 9 and Figure 4,
TABLE 8. Results of temperature and humidity monitoring data in severe Environment.

| Environmental status | Test number | Soil temperature (°C) | Soil moisture (%) | Air temperature (°C) | Air humidity (%) |
|----------------------|-------------|-----------------------|------------------|----------------------|-----------------|
|                      | 1           | 3.81                  | 55.87            | 11.15                | 41.23           |
|                      | 2           | 3.92                  | 56.14            | 11.36                | 41.58           |
|                      | 3           | 3.95                  | 57.96            | 10.87                | 42.21           |
| Low temperature      | 4           | 4.18                  | 57.64            | 10.32                | 43.64           |
| environment          | 5           | 3.26                  | 56.87            | 9.99                 | 42.87           |
|                      | 6           | 67.87                 | 71.59            | 27.63                | 43.98           |
| High temperature     | 7           | 64.98                 | 70.55            | 27.54                | 43.74           |
| environment          | 8           | 64.88                 | 70.24            | 27.96                | 42.05           |
|                      | 9           | 65.36                 | 70.36            | 27.44                | 42.57           |
|                      | 10          | 63.18                 | 71.17            | 27.06                | 40.19           |

FIGURE 4. Analysis of temperature and humidity monitoring data in severe environment.

in which data 1-data 5 is the measurement result at low temperature, Data 6 - data 10 are measurements at high temperature. The test results show that the system can work in high temperature, low temperature, high humidity and other extreme environments, and has practicability and reliability.

V. CONCLUSION
With the continuous development of economy, the importance of land environment becomes more prominent, which to a certain extent affects the national economic construction and social stability. The establishment of land resources sustainable use standards can provide guidance for the management and utilization of land resources, and provide theoretical basis for environmental protection and land security in China. The construction of land resources sustainable monitoring system is the necessary prerequisite to achieve this step. Through the monitoring system of sustainable use of land resources, we can quickly grasp land information, predict the development trend of land environment, and provide solutions to practical problems. The monitoring system based on the Internet of things is a new and intelligent monitoring system. Compared with the traditional monitoring system, it has more advantages. Its accuracy has been greatly improved, especially in the extremely harsh environment, which is a new breakthrough for the related research at home and abroad. The monitoring system constructed in this paper is still in the primary stage of research. Through experimental analysis, we believe that the system still has a lot of room for improvement. We believe that the ultimately optimized monitoring system can better monitor land resources and become a national monitoring system for sustainable use of land resources, giving full play to its value and role in practice.

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