

# The Research of Soil Moisture on Digital Monitoring System

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**Abstract:** Soil Moisture is the Most Important and Commonly Used Soil Information. It is the Basis of Scientific Control and Regulation of Soil Water Status for Water-Saving Irrigation, Scientific Use of Water and Irrigation Automation. the Rapid and Accurate Determination of Soil Moisture in Farmland is of Great Significance for the Determination of the Gain and Loss of Soil Moisture during the Growth and Development of Crops, So as to Make Irrigation, Fertilization Decisions or Drainage Measures. Therefore, the Monitoring of Soil Moisture is Indispensable in All Kinds of Agricultural Water and Soil Engineering Management, Agricultural Experiments, Agricultural Meteorology, Irrigation Management and Drought Monitoring. the Measurement of Soil Moisture Can Be Carried out by Using the Soil Moisture Monitoring Station Located At a Fixed Time.

## 1. Introduction

The digital soil monitoring system is a high-precision data collector which integrates the analysis of soil temperature, humidity, soil conductivity, light intensity, pH value, salt and other parameters. The system is mainly composed of sensor monitoring terminal, transmission network, environmental data management software system of monitoring center, etc. The monitoring terminal adopts real-time signal analysis technology, which can conduct real-time analysis on the collected signals, monitor and analyze the characteristics of the environment, actualize remote data telemetry, event monitoring and automatic system calibration through wireless or wired network transmission, and finally form the soil moisture monitoring report in the monitoring area, providing basis for urban greening and agricultural development, so as to improve the quality of people's life in cities and provide scientific basis for agricultural activities.

## 2. Constitution of Soil Moisture Monitoring System

The system consists of four parts: monitoring center, communication network, remote monitoring equipment and soil moisture detection equipment. The hardware of the monitoring center is mainly composed of servers, computers, switches, printers, etc. The software mainly consists of operating system software, database software and soil moisture monitoring system software. The communication network includes GPRS wireless network and Internet public network; the remote monitoring equipment can be divided into municipal power supply soil moisture monitoring terminal, solar power supply soil moisture monitoring terminal and battery power supply soil moisture monitoring terminal according to the power supply type. It is recommended to select solar power supply monitoring equipment; according to the monitoring requirements, the soil moisture detection equipment can use one way of soil moisture sensor to realize single monitoring The multi-channel soil moisture sensor can also be used, and the sensor can be arranged at different depths to achieve the detection of soil moisture in the profile of the monitoring point. The system framework is shown in Fig. 1.

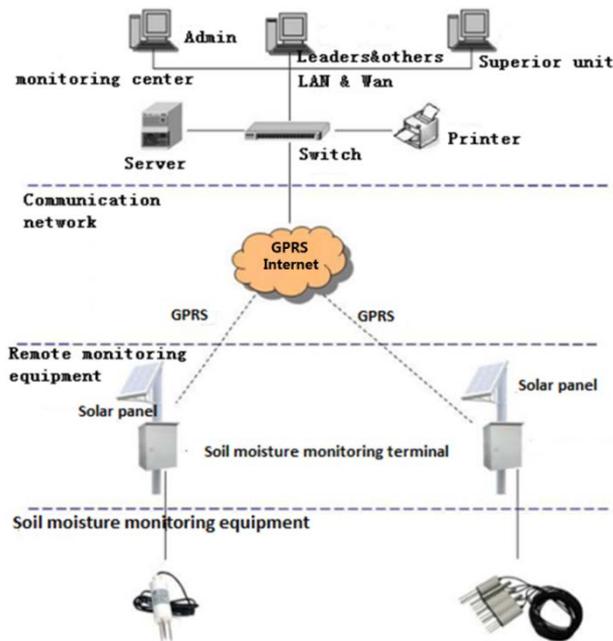


Fig.1 The System Topology

At the same time, corresponding sensors can be added according to the monitoring requirements to monitor the soil temperature, soil conductivity, soil pH value, groundwater level, groundwater quality, air temperature, air humidity, light intensity, wind speed and direction, rainfall, environmental CO<sub>2</sub> concentration and other information, so as to meet the needs of system function upgrading.

### 3. The Function of System

The Soil moisture detection terminal can realize all-weather continuous monitoring. The field remote monitoring equipment automatically collects the real-time data of soil moisture, and uses GPRS wireless network to realize data remote transmission; the monitoring center automatically receives and stores the monitoring data of each monitoring point to the database. The main functions of the system are as follows:

- (1) Real time monitoring of soil moisture, each monitoring point can flexibly carry out single way measurement or multi-channel profile measurement.
- (2) When the soil moisture exceeds the preset limit value, the alarm information will be uploaded immediately.
- (3) It can monitor soil temperature, conductivity, pH value, groundwater parameters and meteorological parameters.
- (4) The frequency of data acquisition and storage can be adjusted flexibly, and the working parameters of monitoring equipment can be set remotely.
- (5) The remote monitoring equipment only supplies power to the sensor when collecting data. On the one hand, it saves energy, on the other hand, it avoids the measurement error caused by the change of soil physical properties caused by long-term power supply.
- (6) GPRS, SMS, LAN and other communication modes are supported, and GPRS wireless communication is recommended.
- (7) The monitoring data can be reported to multiple centers at the same time.
- (8) It has the function of remote equipment maintenance and can expand the function of remote photographing.
- (9) It has the statistics and analysis functions of monitoring data and alarm data, and the data report can be exported and printed out.
- (10) The monitoring system software has GIS function, which can display the detailed distribution position of each monitoring point on the map

#### 4. The Soil Moisture Detection Equipment(Lk23a)

Lk23A: The soil temperature and humidity detection RTU is a professional data collector for monitoring soil temperature and humidity. It integrates 4G / 3G / GPRS wireless communication function and ultra-low power consumption. Internal integration of high-precision analog quantity acquisition and switching quantity, pulse quantity acquisition. The product is advanced in technology, stable and reliable, compact in size, and easy to install. It adopts the protection of copper burning and netting to strengthen the temperature resistance, pressure resistance and damage resistance of the probe. It is suitable for municipal green land, agricultural greenhouse, flower, nursery, lawn and other occasions where the soil temperature and humidity environment needs to be detected. As shown in Fig.2:

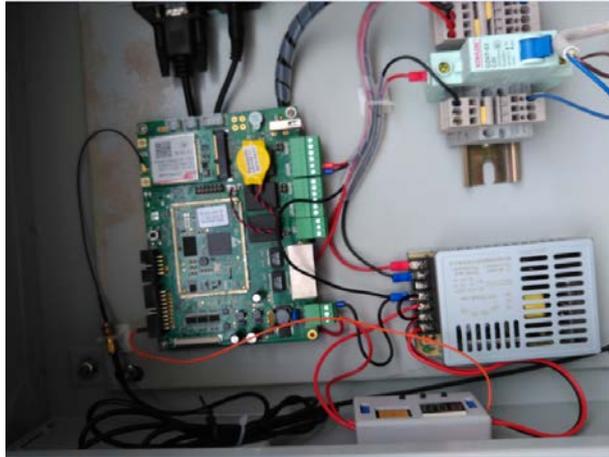


Fig.2 The Soil Moisture Detection Equipment(Lk23a)

The equipment has the acquisition and control ability of RTU and the wireless communication ability of DTU, which can completely replace the traditional networking mode of PLC + DTU or RTU + DTU. It supports a variety of industrial communication protocols, can be connected with configuration software to form a network, and is convenient for users to construct the whole measurement and control system. Its main features are as follows:

(1) The special soil temperature and humidity detection module is used to detect and analyze soil temperature and humidity data.

(2) The detection terminal supports data acquisition and detection of multiple sampling points, with a maximum of 3.

(3) The equipment supports 4G / 3G / 2g wireless transmission.

(4) The equipment has high precision detection: humidity:  $\pm 4.5\%$  RH, temperature:  $\pm 0.5$  °C, salinity resolution: 1mg / L

(5) The data can be reported automatically and regularly, report every change, and the cycle can be set.

(6) The server address can be IP address.

(7) The working parameters of the equipment can be configured remotely.

(8) The working parameters of equipment can be configured through keyboard and display interface.

(9) The clock is automatically synchronized with the server.

(10) When the device is idle, it will automatically enter into the low-power sleep state, supporting keyboard wake-up, di input wake-up, serial port wake-up, GPRS / SMS / phone wake-up, timed automatic wake-up, etc.

(11) The equipment supports external expansion function detection, such as soil salinity, conductivity, etc.

#### 5. The Monitoring Platform Software System

(1) The monitoring platform software system should have high reliability, security and ease of

use and other basic requirements.

**Reliability:** the system must adopt the whole component technology architecture, the core modules have good inheritance, and try the parallel processing technology;

**Security:** adopt multi-level security measures, each operation involving control equipment needs secret authentication, and unauthorized personnel cannot operate the equipment; the connection between client and server as well as the connection between terminal equipment and server need layer by layer authentication to ensure the high security of the system.

**Progressiveness:** every part of the software adopts the most popular technology nowadays to ensure the advanced nature of the system.

**Ease of use:** with the use of electronic map (MapInfo), the geographical location of the device is clear at a glance. The user can complete the operation of the device through the electronic map, and each step of operation has Chinese prompt, which is convenient to use.

(2)It can realize the functions of soil moisture analysis, wireless transmission, alarm management, equipment management, etc.

**The analysis of soil moisture:** it can realize the data collection of temperature and humidity, carbon dioxide, soil moisture, illuminance, etc. in each monitoring area, and analyze, count and display the soil moisture information. The system carries out continuous monitoring, performs the function of comparative analysis of soil moisture and shows it in the form of charts. Through the comparison, it can predict the impact of the fluctuation of soil moisture and help managers to find and solve problems as early as possible.

**Wireless transmission:** Monitoring data is transmitted under 2G,3G or 4Gmobile communication system environment.

**Alarm management:** the monitoring environment and equipment of the garden green land will give an abnormal alarm, which will prompt / inform the management personnel to respond in time.

**Equipment management:** equipment management. The platform supports the access of a variety of wired and wireless sensor equipment. With the needs of the project, hardware equipment can be increased or decreased at any time.

The hardware and software of the system adopt modular structure, and the main functions can be configured according to the needs of users. In addition to the statistical analysis function of environmental parameters, the real-time spectrum analysis function can be selected, as well as the meteorological module and GPS global positioning module can be added to realize the mobile monitoring of noise

## 6. Summary

This paper introduces the function of the soil moisture monitoring system, mainly expounds the function of LK32A, which is the soil moisture monitoring equipment in the composition of the soil moisture monitoring system, and puts forward the requirements for the function of the system platform software.

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