





## Design and Implementation of Computer Aided System for Landscaping Plant Selection

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**Abstract.** Reasonable terrain, climate and other conditions are suitable for plant reproduction, which is an important guarantee for the origin and domestication of many plants. However, the lack of a comprehensive and systematic understanding of landscape plant species by landscape architects has led to single plant species or poor growth. Choosing plants according to local conditions so that each plant can maximize its ornamental and functional properties is an important subject in garden landscape planning. This article will start with the selection of computer-aided systems for landscaping plants. It is designed to assist users in designing landscaping plants, optimizing plant species with specified conditions, and its main function is to search for plant species suitable for planting according to plant and environmental factors. The development and implementation of the system in this article first collected the data of the main landscaping plants and established a database of garden landscape plants; then designed the human-computer interaction interface to enable users to access the database conveniently and quickly. Users can log in to the system interface and select the type of landscape plants to be planted. Characteristics, and the environmental conditions of the planned area, to obtain information on the biological characteristics, ornamental characteristics, and garden uses of alternative plants that meet user needs.

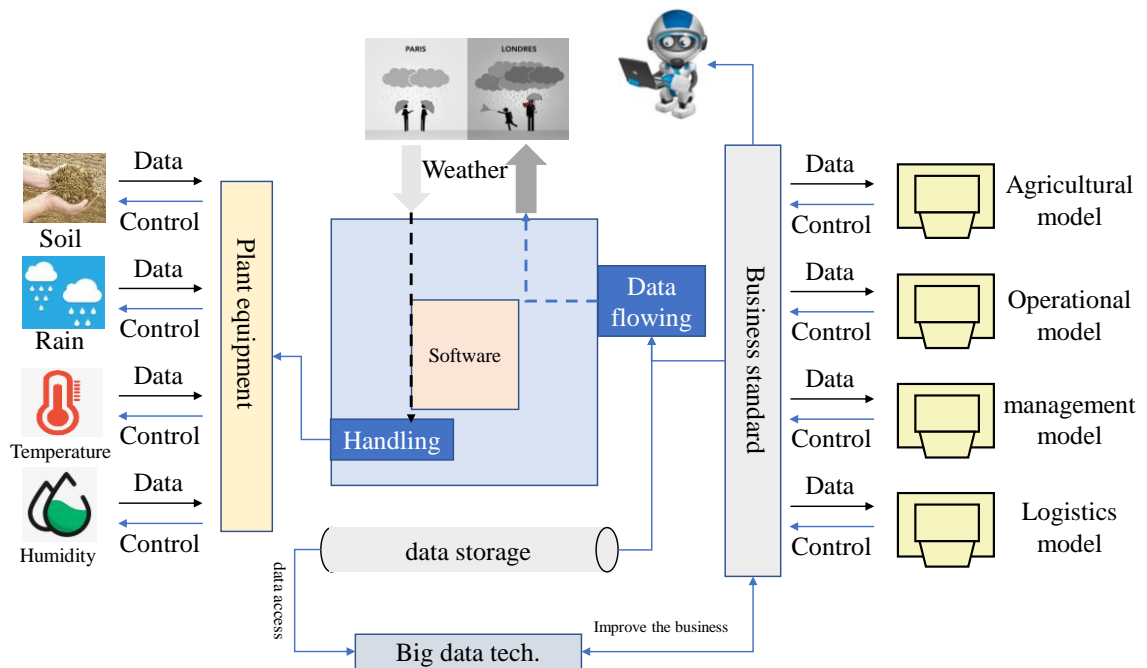
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### 1 INTRODUCTION

The topography and climate of the earth's environment are complex and diverse. It has an excellent environment suitable for plant reproduction and is the center of the origin and domestication of many plants.[1] These characteristics provide rich species for landscape architects to choose plants and plant them. However, the lack of a comprehensive and systematic understanding of landscape plant species by landscape architects has led to single plant species or

poor growth. How to choose plants according to local conditions so that each plant can maximize its ornamental and functional properties is an important subject in garden landscape planning. Crossa, J et al. [2] have also compiled a number of garden and landscape plant databases according to their needs. In some developed countries, computer-managed plant cards were established as early as the 1960s, and network structures were formed in the 1980s.[3] Among them, the interactive woody ornamental plant selection network query database reported by Goodness, J [4] and others mainly collects tree species that can be used for garden landscape planting. The interactive woody ornamental plant selection network query database, Chongqing garden plant database and Hainan tropical plant group database are equivalent to forest landscape plants. Most of them are used for plant cognition and management functions.[5] The applicability of plant matching functions is not high. The computer-aided matching system for landscaping and planting is designed to assist users in optimizing suitable plant species. Its main function is to search for plant species suitable for planting according to plant elements and environmental factors. The system provides a variety of ways to query plants as shown in Figure 1, which can help landscape architects quickly and accurately select plants in accordance with local conditions, maximizing the ornamental and functionality of each plant [6]



**Figure 1:** The system that provides a variety of ways to query plants.

With the development of the city, people have further pursued the living environment, and the government has begun to vigorously develop urban greening construction.[7] The city's garden management includes the conception of the plan, the design of the landscaping project, the development of the construction project, the acceptance of the landscaping project, the putting into use of the landscaping project, and the subsequent maintenance of the landscaping project. This process is cumbersome and complicated. Petschenka, G. et al. [8] reported that it is related to the redistribution and functional allocation of urban land resources, and it is also related to the daily leisure activities of citizens. When constructing green projects, it may also involve the resettlement and compensation of residential land that is involved. And other issues. Relevant managers must understand the credibility of urban landscaping construction with a comprehensive, truthful, and flexible attitude in order to obtain a scientific plan. In the process of continuous urban

development, urban garden construction projects are increasing. According to Reisenman, C. E. et al. [9], in many cities, landmark buildings and relatively novel designs have emerged in terms of landscaping. With the increase of urban landscaping projects, the difficulties of construction have become more and more difficult. Some management units rely on traditional methods to rely on paper drawings for design, archive paper documents, and rely on manual labor to manage and record garden data. This traditional method is difficult to ensure accurate statistics of urban greening and area, rare ancient trees and parks, and other information. Such a huge workload can only lead to inefficiency due to manual management.[10] The use of paper records will inevitably encounter incomplete records, lost records, and inconvenient search, which affect the quality of management work. As traditional management methods have repeatedly reduced work efficiency, urban garden information management is facing difficulties such as increased data management dynamics, a wide range of data records, and accuracy of data information. In order to ensure efficient urban gardening work management, it is particularly important to build a digital management system. In order to ensure the traceability of data, it is necessary to start with the most basic data and manage all the data through an integrated digital management platform to prevent data diversion, and ensure the informatization, efficiency, and standardization of urban gardening management by Zhang, F et al. [11]

In this article, our team completed the establishment of a computer-aided matching system for landscaping from technical support to database. The development and implementation of the system in this article first collected the data of the main landscaping plants and established a database of garden landscape plants; then designed the human-computer interaction interface to enable users to access the database conveniently and quickly. Users can log in to the system interface and select the type of landscape plants to be planted. Characteristics, and the environmental conditions of the planned area, to obtain information on the biological characteristics, ornamental characteristics, and garden uses of alternative plants that meet user needs. Relying on the digital management of urban gardening can make an intuitive analysis of the degree of urban greening. Through computer technology, remote sensing images, office software, etc. to build a digital system platform for urban landscaping management, the landscaping digital management system includes the release of construction information for urban landscaping projects, an exchange platform for opinions on landscaping project construction, landscaping data management, and Decision-making function.

## **2 ACQUISITION AND PROCESSING OF PLANT SELECTION DATA**

In this article, by comparing and contrasting plant literature data such as "Environmental Landscape Greening Planting Design", "Landscape Tree Species Manual" and "Landscape Design Tree Species Manual", we collect and organize plant data from two aspects: environmental factors and plant elements. A total of more than 800 plant texts were collected by the above methods as shown in Figure 2.

### **2.1 Classification of Environmental Elements**

Like other organisms, the growth and development of garden plants is determined not only by their own genetic characteristics, but also by the external environmental factors [10]. The selection of landscape plants suitable for the environmental conditions such as ground temperature, light, moisture, and soil is important for the growth and cultivation of garden plants. Therefore, when collecting plant environmental elements, it is classified into 5 aspects: heat factor, light factor, water factor, soil factor, and applicable area.

### **2.2 Classification of Plant Elements**

When landscape planners choose plants, they usually match plants with different ornamental characteristics such as different tree shapes, flowering periods, and flower colors according to the actual situation of the planned land, as shown in Figure 3.

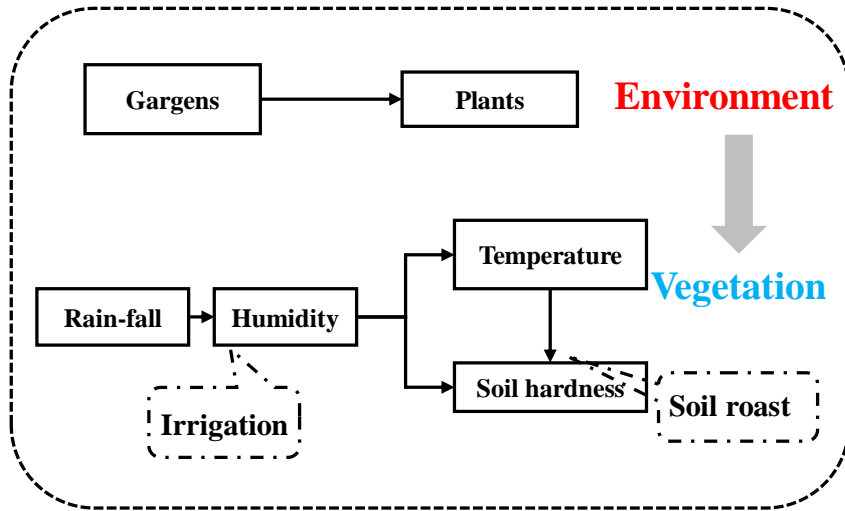


Figure 2: the plants texts collected from the literature.

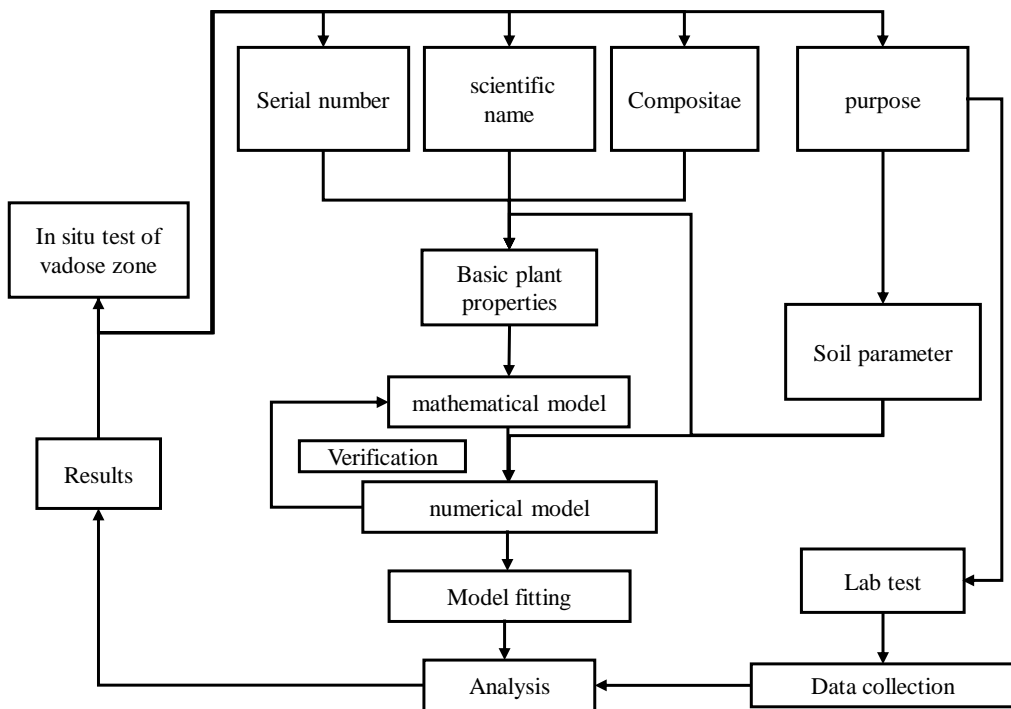


Figure 3: scientific collection of matching plants with different ornamental characteristics.

Therefore, while collecting environmental factors of plants, they are also classified according to the ornamental characteristics of plants.

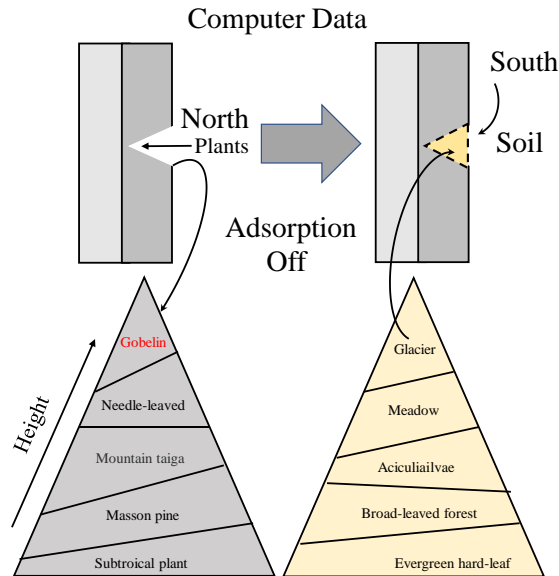
(1) Garden plants can be divided into 6 types according to different uses when they are configured: trees, shrubs, vines, bamboos, palms and herbs. Among them, leather is divided into: biennial flowers, perennial, bulbous flowers, aquatic flowers, Lawn cover.

(2) According to the main ornamental position of the same forest plants, it is divided into 4 types: 1. Flower-viewing plants: flower color, flower shape, floral fragrance, etc. are outstanding. Among them, the ornamental characteristics of flower-seeking plants were collected according to four aspects: flower color, flowering period, floral fragrance, and flower and leaf order. Flower color is divided into 4 types: red flower, yellow flower, purple flower, and white flower; flowering period is divided into flowering period and flowering period; floral fragrance is divided into aromatic and non-aromatic; flowers and leaves are divided into flowers and leaves first. There are 3 types of flowers, leaves and flowers, and leaves after flowers. 2. Ornamental plants: beautiful trees, mainly divided into cylindrical, tower, oval, conical, spherical, umbrella-shaped, weeping-shaped, and cymbal. 3. Leaf-viewing plants: leaf color, leaf shape or leaf size, and unique way of growing. Leaf color is mainly divided into 4 types: new leaf colored, autumn colored, constant colored, and spotted colored. 4. Fruit-viewing plants: the fruit is remarkable and the fruit is full.

**3 DATABASE CONSTRUCTION**

**3.1 Data Requirements**

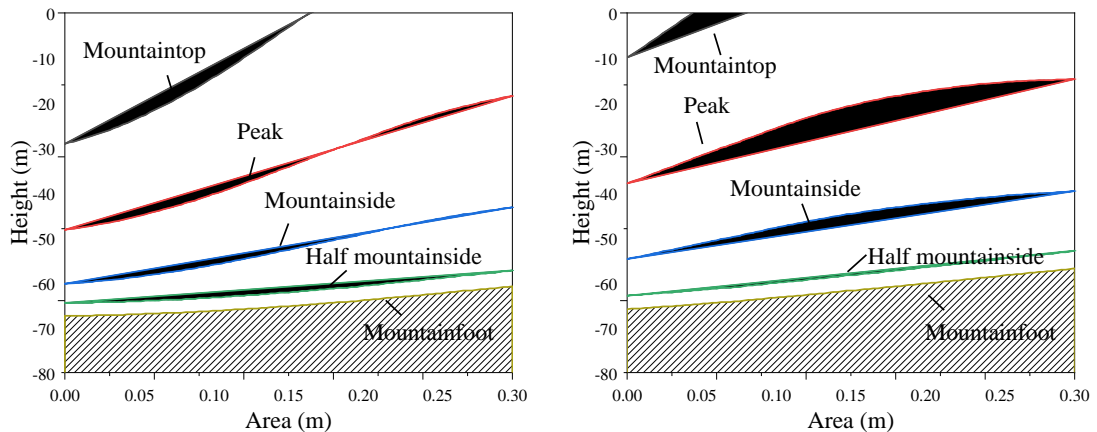
The data involved in the computer-aided system of landscaping are related to the basic information of plants, such as trees and shrubs or flowers and fruits. On the other hand, because this system is applied to the auxiliary design of garden landscape, the data in the system also needs to be considered from the perspective of landscape planning design, that is, to organize the data from the two aspects of environmental factors and plant factors. Among them, the environmental factors include: thermal factors, light factors, water Gangzi, soil Gangzi and other factors. Plant elements include plant types and ornamental characteristics, and ornamental characteristics can be subdivided into characteristics such as flower viewing, shape viewing, leaf viewing, and fruit viewing. In addition, because some terms of garden greening are not easy to understand, it is necessary to organize data to explain the terms of the same forest greening. Database requirements analysis E-R chart shown in Figure 4.



**Figure 4:** Database requirements analysis.

### 3.2 Database Logic Design

The database of the computer aided system for landscaping and planting is based on the data requirements, and the data is merged and organized according to the rules of standardized processing. It includes several attribute tables including the landscape plant concept attribute table, plant basic attribute table, flower-viewing plant attribute table, shape-viewing plant attribute table, leaf-viewing plant attribute table and fruit-viewing attribute table, as shown in Figure 5.



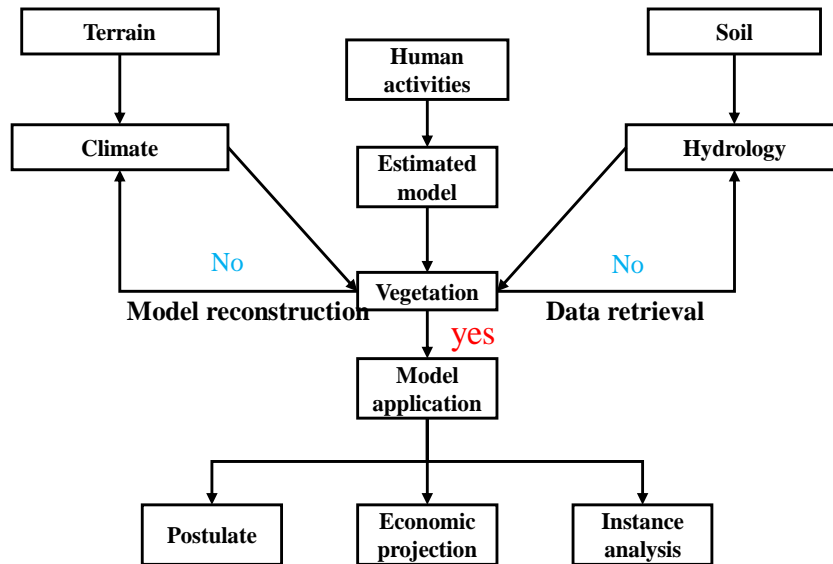
**Figure 5:** The process of audio speech recognition.

### 3.3 System Function Design

The user uses the computer-aided system of landscaping and planting, and selects the types and characteristics of landscape plants to be planted, and the environmental conditions of the planned place to obtain the plant species that meet the user's selected conditions, and can save the query results provided by the system. Because the selection of garden plants is mainly considered from two aspects of environmental factors and plant factors, the system also provides query by environmental elements and query by plant elements accordingly.

At the same time, the system supports fuzzy query, making the query of landscape plants richer and more efficient. As long as the query keywords entered by the user match the information stored in the database arbitrarily, the results can be queried without consistency. In addition, the function of "custom SQL query" provides users with a platform for autonomous query conditions and makes the query results more in line with the personalized requirements of advanced users, as shown in Figure 6. The function of the system is shown in Figure 6. Users can select 5 different query functions for heat factor, light factor, water factor, soil factor, and applicable area, or they can select 2 or more query functions together. After the user selects the type that meets the environmental conditions of the planned place, he can query the corresponding candidate plant information, including serial number, middle name, scientific name, family name, height, biological characteristics and ornamental characteristics, garden uses, etc. Block users can select plant categories for query. In the plant category query panel, click on the requirements for the plant category, and you can query the plant information that meets the requirements. Users can also select viewing characteristics for query. The user clicks on the requirements for ornamental characteristics of garden plants in the query panel, and can query the information of the corresponding plants. According to the above several different query functions, after selecting the plant type and ornamental characteristics that meet the requirements of the planned location, you can query the corresponding candidate plant information, including serial number, middle name, scientific name, family name, height, biological characteristics and Ornamental characteristics,

garden uses, etc. In order to meet the needs of user query flexibility, the system also provides the function of custom SQL query. Users can open the custom SQL query panel and build SQL based on the table name, field name, and other basic SQL statements provided by the panel. Statement, the system can query based on this statement. For example, the attribute query based on the forest use of plants is not involved in the first two query submodules, but the query can be customized in the SQL query panel. If you query the types of plants grown as hedges, you can define the statement as follows: from the basic attribute table of plants, you can query the plant information applicable to hedges.

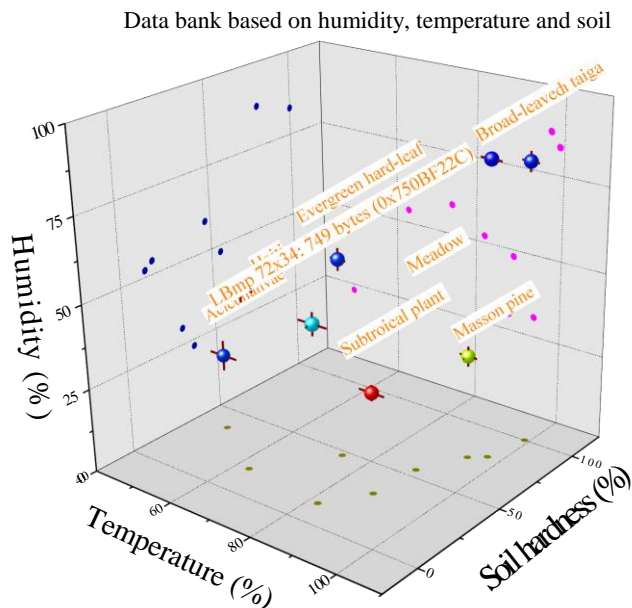


**Figure 6:** Query keywords entering the information stored in the database arbitrarily.

#### 4 REALIZATION OF DIGITALIZATION OF GARDEN GREENING

The operation process of the digital management system is not only the electronic processing of the entered information, but also the analysis and processing of the data to obtain reasonable results, and use this as the scientific support for managers to make decisions. The "Demonstration Guide for Urban Construction Management Informatization (Draft)" states that digital management platforms include portal systems, office systems, professional application systems for industry sectors, and information interaction platforms. The platform uses multiple data for analysis and utilization to achieve the purpose of auxiliary management. The author believes that the overall framework of urban digitalization includes four main parts, namely the infrastructure layer and resource management layer, the comprehensive service layer and application decision-making layer, etc. [4]. As digital management has brought innovation to urban garden greening management, the construction of urban garden greening digital management has been promoted in major cities. The main content of the digital management system is composed of the following three parts. Abandon the old office model and carry out garden green management in a digital way. The digital management system can cover the basic information of the industry, management structure, online approval business, employment status filing, public information transparency, urban garden construction projects. The announcement of the project, the follow-up of the project construction status, etc., relying on the digital management system, the masses can know the construction progress on the platform at any time, and can speak freely on the platform, which greatly enhances the participation of the masses, and also plays a role of public opinion supervision. Because all the information is published through the network platform, the paper

notification method is abandoned, that is, the time for information transmission is reduced, the office cost is reduced, and a highly efficient and environmentally friendly office is realized in the true sense. With the development of social economy, people's lifestyles have changed, and people have new requirements for their living environment. Urban gardening construction should not make decisions based on past construction experience. It should be based on a scientific perspective and make an informatization analysis of urban gardening. Strict consideration is given to the size and geographical location of the garden, the protection of some old trees and rare species of trees, the reinvestment of saplings and the selection of plant types. These can use digital management systems to predict the development of the project, and Make a prejudgment of the profit situation to ensure the maximum profit of the project. Compared with the traditional solution, the computer matching scheme has higher output at different wavelengths and is more reasonable. For example, as shown in Figure 7, we can select the proper plants through the data bank easily.

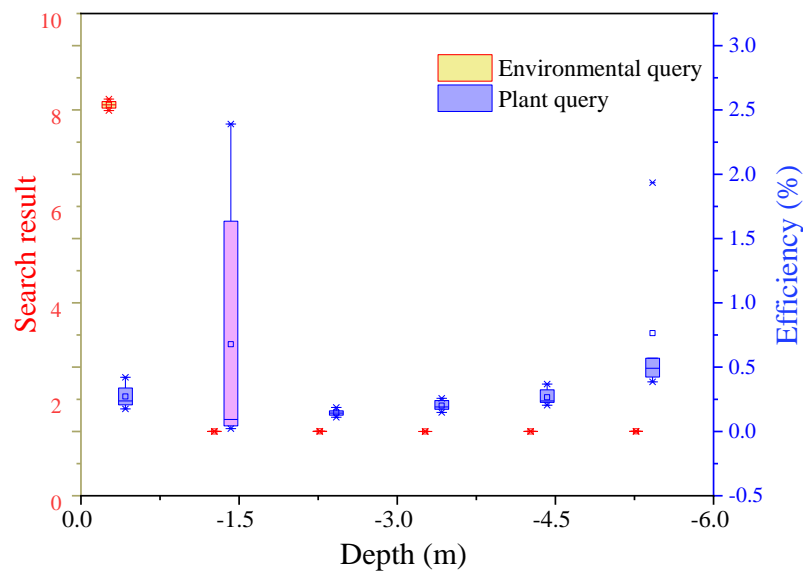


**Figure 7:** Data bank based on humidity, temperature and soil.

Through the use of digital management system to understand the basic information of garden management and maintenance units and managers. By using monitoring equipment, managers can remotely understand whether the garden management is in good condition and the operating status of the garden facilities is good. When abnormal conditions occur, the gardener can find the problem as soon as possible and report the fault in time through information to ensure the maintenance personnel. Able to repair equipment in a timely manner. The management personnel can timely reach the instructions through the platform, which greatly shortens the reporting time for superiors and subordinates. This management method guarantees the timeliness and scientificity of the management work, and greatly improves the work efficiency. With the rapid development of science and technology, more and more cities are actively moving towards smart cities. Digital reforms in all walks of life have begun to improve management quality through digital management of information technology and other means. There is no doubt that the digital management system is an important guarantee for urban gardening management. Urban landscaping management system covers a wide range, including data disclosure, government



information and decision-making. The participation of the digital system of government affairs in the landscaping industry has played a supporting role in achieving electronic office, transparency of information, and improving the efficiency of management work; the urban landscaping management platform announces the information of urban construction projects in a timely manner, updates the project progress in a timely manner, And build a database to facilitate managers to enter information, query information, archive information in a timely manner while preventing information loss. The platform management personnel should make good use of the advantages of the platform, so that the public can follow up the situation of urban garden construction projects from the platform in time and make suggestions on the platform. Let the public experience the convenience brought by the digital management system of urban gardening. It is precisely because the digital management system has greatly promoted the construction of urban gardens. It guarantees the smooth development and subsequent maintenance of urban garden construction work. It provides a much more effective way to get the right data, as shown in Figure 8.



**Figure 8:** The depth dependent searching results and efficiency.

## 5 CONCLUSIONS

With the popularization of computer technology, modern gardening project management needs to be combined with informatization to build a scientific and efficient digital management information system to effectively promote the modernization process of urban gardening. Based on some characteristics of urban landscaping work, this paper analyzes the effective application value of landscaping management information system in landscaping work. Based on the main characteristics of landscaping management informatization, the development direction of landscaping management system is proposed. Aiming at the problems in garden management, it is necessary to attract high-quality talents, use modern information technology, integrate with modern management science, and promote the continuous innovation and development of garden greening project management. Garden greening is not only an important guarantee for improving the living environment, but also an effective resource that can be recycled. It combines the principle of greening project management with digital technology to build a garden greening

information management system to achieve as much data as possible in the process of garden greening management. Openness and sharing of information resources could realize the efficient development of urban landscaping, make the relevant statistical data permanent and can be queried in real time, which is helpful for decision-making reference in future work.

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