Research Article

Design and Discussion on Information Management and Control System of Agricultural Machinery and Equipment

Ling Ma

Chongqing Industry Polytechnic College, Chongqing 401120, China

Correspondence should be addressed to Ling Ma; 1420740130@xs.hnit.edu.cn

Received 3 August 2022; Revised 10 September 2022; Accepted 20 September 2022; Published 4 October 2022

Academic Editor: Jackrit Suthakorn

Copyright © 2022 Ling Ma. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

In order to solve the problem of low development efficiency of agricultural mechanization information network system, a design and discussion method of agricultural machinery equipment information management and control system is proposed. This paper introduces the technologies required to realize the agricultural machinery operation management control system: Android development technology required to develop mobile phone positioning software, Internet map API for displaying location data, and construction of agricultural machinery resource allocation model for the realization of the scheduling module. Different objective functions are set, and the model results in different situations are obtained through experimental data. The experimental data are in the case of schedulable agricultural machinery, if the target is short-distance short-distance operation, it can save time by 0.16 h, and the existing M1 model is in Changying Village, work end time is about 2.5 hours; M4 and M2 models work in the Xuzhuang Village, and the work end time is about 0.5 h; M3 model works in the Jiangtang Village, and the calculation results for different goals are as follows: M1 model first dispatches short-distance operations; the M3 type is dispatched first for short-distance operations; the M4 type operating in Xuzhuang Village is given priority to dispatch short-distance and short-distance operations. According to the analysis of system requirements, each submodule of the system is designed, including the function description and realization method of the module. The history track query module, mobile phone positioning module, and agricultural machinery scheduling module are introduced in detail. Using the Android development technology required by mobile phone positioning software, the information management of user interface, server system, and database is realized, which provides conditions for the collection of agricultural machinery and equipment information and the generation of information management control.

1. Introduction

Agriculture is the foundation of peace. Solving the “three rural” issues has always been the “top priority” of the work of the central government, it is necessary to conform to the development trend of global informatization, and take the agricultural Internet of Things as the core and most fundamental information technology of agricultural informatization, firmly grasp the information revolution and provide a major historical opportunity for agricultural modernization to “overtake on the curve,” aim at the development direction of smart agriculture, and make up for the shortcomings [1]. The informatization of agricultural machinery is closely related to China’s agricultural development and land reform policies, when the land circulation is accelerated and the land is concentrated on a large scale, the demand for agricultural machinery informatization will explode. With the advancement of land reform, the demand for large-scale agricultural machinery will further increase, agricultural information equipment mainly includes satellite positioning systems, agricultural machinery automation, precise measurement, and cultivated land information monitoring equipment. Combining its own technology and market reserves, Borchuang Linkage conducts market entry through “agricultural machinery information management and public service system” [2]. The informatization of agricultural machinery is practically applied to management, and the vehicle networking platform and vehicle data service solutions are provided for governments at all levels [3]. The main module of the agricultural machinery scheduling
module is the operation distribution module, the operation distribution module displays the agricultural machinery operation area to the supervision department in the form of a heat map, first, in the form of a list, displays the operation heat map of all the plots of agricultural machinery in this area, so as to visually show which area has a large distribution of operations, which area uses more agricultural machinery resources, and records the operation area of each module at the same time, when the operation heat map is clicked, a suggested agricultural machinery resource scheduling plan will be given. It is suggested that which agricultural machinery is needed for the plot to be operated, which can reduce the operation time and improve the operation efficiency [4]. At the same time, for the allocation of agricultural machinery resources, it is necessary to consider establishing an agricultural machinery resource allocation model. After background calculation, the resource allocation plan is determined, and the agricultural machinery and agricultural machinery information are returned to the front-end, and the front-end callback function accepts the information, when the user clicks on the heat distribution map, the resource allocation plan is pushed to the user, provides auxiliary decision support for users to dispatch agricultural machinery, Figure 1 and shows a large-scale agricultural machinery regional dispatch management system based on the Internet of Things. The improvement of the level of agricultural mechanization, changes the agricultural production mode mainly based on human and animal power into mechanized operation to improve agricultural productivity, enhances the ability to fight natural disasters, reduces the workload of farmers, and increases farmers’ income. It has become one of the main driving forces for agricultural modernization and precision [5].

2. Literature Review

For this research question, Pan et al. developed a decision support system for formulating crop field planting plans and operation plans [6]; Zhang et al. also developed a decision support system, which can be based on factors such as regional differences in crops, farm characteristics, ownership, and model of agricultural machinery and equipment, which directly provide farmers with operational decision-making opinions, and output the optimized agricultural machinery system [7]. Cheng et al. developed a model of “evaluation of agricultural machinery system,” input crop varieties, crop rotation time, and field operation process, the model can give the supporting scheme of agricultural machinery system [8]. Liu et al. took the agricultural machinery management in Zhejiang Province as the research background, the programming language used was Visual Basic, and the database was supported by Access and Visual Fox Pro, a set of computer multimedia decision support system with agricultural machinery multimedia information query, prediction, and auxiliary decision-making functions has been developed [9]. Hajebrahim et al. designed and developed a networked decision support system for agricultural mechanization development. The system takes Internet/Intranet as the technical core, the architecture adopts Client/Server structure, the ASP program adopts Visual InterDev6.0 to develop, and Visual Basic6.0 is adopted to develop COM components [10]. Setyohadi, Rehman, S. and others combined information processing technology, system integration technology, database and other technologies, research and development of a set of “GIS (Geographic Information System for short, geographic information system) based agricultural mechanization management decision support system [11]. Liu et al. proposed the use of visual basic programming language, SQL server 2005 database, a set of agricultural machinery selection decision support system has been developed, and multiple selection models have been established in the system, which provides decision support for job matching agricultural machinery. However, the functions involved are relatively single [12]. Jiang et al. developed a set of agricultural machinery job scheduling system based on GA (Genetic Algorithm for short, Genetic Algorithm), and for the agricultural machinery scheduling problem, an improved genetic algorithm is proposed to solve it [13]. The system studied by Kim et al. also combines Beidou satellite navigation technology and geographic location information system, a reasonable agricultural machinery scheduling scheme is generated, and the cross-regional operation scheduling of agricultural machinery is realized. However, its function is too single, and it is only reflected in the problem of job scheduling, and the data resources have not been fully exploited and utilized [14].

Based on current research, the author proposes the realization of agricultural machinery equipment management information system based on network technology, an agricultural machinery resource allocation model is established for agricultural machinery operation scheduling, and different objective functions are set to recommend the best scheduling scheme for users, analyze actual agricultural machinery allocation and scheduling problems, establish agricultural machinery resource allocation models, set different objective functions, and collect real data. After verifying the model, the scheduling scheme in different situations is obtained, and combined with the system, the optimal scheduling scheme is recommended to the user to realize the agricultural machinery scheduling function. According to the analysis of system requirements, each submodule of the system is designed, including the function description and realization method of the module. It specifically introduces the historical track query module, mobile phone positioning module, and agricultural machinery scheduling module. The management of the basic information of agricultural machinery, the management of agricultural machinery operation information, the management of agricultural machinery location information, the management of regional agricultural machinery information, and the scheduling of agricultural operations are realized.
The management efficiency of both the supervisory department and the enterprise has been improved.

### 3. Methods

#### 3.1. Related Technologies of Agricultural Machinery Operation Management System

**3.1.1. GPS global positioning.** GPS (Global Position System) consists of three parts: the space part composed of 24 satellites, the ground control system, and the user equipment part (accepting GPS signals to obtain positioning information). 98% of the world has achieved GPS coverage [15, 16]. At present, many industries use GPS, such as surveying and mapping, navigation, timing, marine, aerospace and so on. The average altitude of these 24 satellites is 20,200 kilometers, and they are evenly distributed on 6 orbital planes with an inclination of 55°, and each orbital plane has 4 satellites. This even distribution method ensures that more than 4 satellites can be observed in any area of the world, that is, satellite signals can be received at any location at any time, accept all-weather continuous positioning and navigation services provided by GPS.

GPS positioning methods, including pseudo-range positioning, carrier positioning, Doppler positioning, and satellite radio interference positioning [17, 18]. Pseudo-range positioning is the most common positioning method. Pseudo-range positioning means that when GPS is navigating and positioning, there will be a sending time when the satellite sends the satellite signal to the GPS signal receiver, the receiver receives the satellite signal at a certain time, that is, the time of receiving the signal, the time difference between the two times is multiplied by the speed of the satellite signal, that is, the distance between the satellite and the signal receiver can be calculated. In theory, only three or more satellites are needed to calculate the distance between the satellite and the signal receiver, but during the transmission of the signal from the air to the ground, due to atmospheric refraction and clock difference, and delay the distance between the two, this distance is called pseudorange. Therefore, when calculating the position, it is also necessary to consider the “clock difference” composed of pseudoranges, and take the three-dimensional coordinates of the signal receiver and the clock difference as the unknown equations, and obtain the three-dimensional coordinates of the signal receiver after calculation. Since the system of equations contains four unknowns, in order to determine the current position information, at least four satellites are required to measure pseudoranges [19].

**3.1.2. Android Technology.** Android is an open source, intelligent mobile operating system based on the Linux kernel. At present, there are billions of mobile devices in the world running Android technology. Android technology is now not only used for mobile phones, but also gradually involved in different fields such as tablets, TVs, and game consoles. At present, Google has released the Android 10.0 version. The kernel of Android is the Linux kernel implemented by C language, and it is specially customized, which improves the operating efficiency of Android [20, 21]. Android runs on top of the Linux kernel, and Android’s Linux kernel controls include security, memory management, program management, network stack, driver model and more. The Android system architecture adopts a layered architecture, which is mainly divided into four layers, from the top layer to the bottom layer, mainly the application layer, the application framework layer, the system runtime library, and the Linux kernel layer.

**3.1.3. Internet Map API.** A lot of data in the agricultural machinery operation management system needs to be displayed to users through maps, and the platform uses Internet maps to display relevant data [22]. With the rapid development of geospatial technology, many Internet companies have provided Internet map services, such as Google Maps, Baidu Maps, and AutoNavi Maps. Developers can not only query the required information in these maps, but also call these maps for secondary development and call the map API to implement custom functions [23, 24].

In this topic, the mobile phone positioning is used to achieve by calling the AutoNavi map. AutoNavi Map API/SDK is a map application interface provided for developers. AutoNavi Map API provides an interface for developers to...
enable developers to complete functions such as positioning, map display, navigation, location search, and real-time traffic. Through the secondary development of AutoNavi map, information such as longitude and latitude, geographic location information, and walking route of the current location can be obtained. AutoNavi map mainly provides the following map interfaces:

The map display interface, that is, the front-end uses JavaScript to call the AutoNavi map to display the map on the front-end interface or in the system. Through this excuse, functions such as map panning, map scale zooming, and map scale can be realized. When developing the system, you must first call this excuse to display the map. Map overlay interface, in this system, if the location information is uploaded through the mobile phone software, it needs to be displayed on the map on the web page, this function can be achieved by calling this interface [25].

Geographical location correction interface: AutoNavi map provides a location correction function, the GPS coordinate information of the terminal location cannot be directly uploaded and displayed on the map, and location correction needs to be performed, which can be achieved by using this interface.

Geographic location reverse analysis interface: this interface can convert the corresponding latitude and longitude coordinates into specific location and other information, and display it to the user in the form of text description, so that the user can quickly locate by latitude and longitude.

3.2. Overall Design. The goal of the agricultural machinery operation management system is to manage the basic information of agricultural machinery, operation management, location management, regional agricultural machinery management, scheduling management, realize the comprehensive management of agricultural machinery, improve the management efficiency and economic benefits of the township cooperatives, and improve the efficiency of the supervision department in the management of agricultural machinery in the region; it is convenient to schedule agricultural machinery, so as to improve the working efficiency of agricultural machinery in the whole area and create the maximum value of each agricultural machinery. The agricultural machinery operation management system needs to realize the management of the basic information of agricultural machinery, the management of agricultural machinery operation information, the reception and processing of agricultural machinery location information data, the scheduling of agricultural machinery operations, and the realization of informatization, real-time, and intelligent management of agricultural machinery, the whole system needs to have functions such as data collection, data communication, data processing, and data storage, and the system needs to be classified into different roles, for example, cooperatives module, and system administrator module, supervisory department module. In summary, the author’s system is mainly divided into four layers: User layer, application layer, data layer, and basic support layer.

The overall workflow of the agricultural machinery operation management system is as follows: first, the agricultural machinery intelligent terminal collects the operation status information of the agricultural machinery (the position of the agricultural machinery, the speed of the agricultural machinery, the driving direction of the agricultural machinery, the operating area of the agricultural machinery, etc.), as well as the data information such as the information of the agricultural machinery terminal, then it is packaged according to the specified data protocol through the GPRS wireless network, and then transmitted to the GPRS processing module, the GPRS processing module transmits the data to the server according to the communication protocol with the server, after the server is parsed, it stores the data in the database, and finally connects to the Baidu map API server through the front-end interface. The location information, job information, historical track, and other records are displayed on the electronic map through the electronic map server, and the front-end and back-end data Ajax interacts, display other data information on the front-end interface.

3.3. Network Topology Design. The agricultural machinery operation management system consists of intelligent terminal, system, and user. The intelligent terminal sends the location information data to the system server through the GPRS network, if the mobile phone software is used for positioning, the data is transmitted to the platform through the mobile network (4G), the system platform parses and stores the data in the database, and finally connects to the electronic map server through the front-end interface. The time of the job process is used as the priority, the shorter the time of the job, the higher the priority. In agricultural machinery operations, the shorter the working time of agricultural machinery, the more priority assigned to tasks. The idea of short-distance priority is to take the shortest time for agricultural machinery to reach the working land as the goal in the agricultural machinery operating system, if an agricultural machine arrives at the operation site first from a certain location, the agricultural machine will be arranged to operate first, other agricultural machinery is considered next. Short working time objective function, it is based on the consideration that agricultural machinery can complete the operation in the shortest time, if a certain agricultural machine can complete the operation first, then the agricultural machinery is arranged to do the work. For short distance and short operation, the shortest sum of arrival time and completion time is considered as the factor, if a certain
3.5. Building Type Construction

(1) When building an agricultural machinery resource allocation model, consider the following factors:
The number of agricultural machinery in each cooperative is known, and the type of agricultural machinery is known; When each agricultural machine is working, except for the failure to stop working, it cannot stop working at other times, a piece of operation field can be completed by one agricultural machine, and the agricultural machine can operate multiple pieces of farmland; The operating power, position information, operating status and driving speed of each agricultural machine can be received normally; When agricultural machinery is affected by uncertain factors such as weather factors and road factors, it is assumed that each agricultural machinery is affected to the same degree; When each agricultural machine is operating, there is no limit on the start time and end time, and it can be serviced when it arrives, but the operation should be ended as soon as possible;

(2) According to the above factors, when establishing the model, the following constraints are assumed:
The location of the operation field and the area of the operation field are known; The number of cooperatives and agricultural machinery, the operating capacity of agricultural machinery, and the type of agricultural machinery are known; The same type of agricultural machinery has the same operating capacity and the same fixed cost, regardless of factors such as the use and loss of agricultural machinery; The model is established for the same type of matching agricultural machinery, and for the smaller operating area, the low-power harvester is allocated; For larger working area, a high-power harvester is assigned;

(3) The parameter settings are as follows:
K: K represents the cooperative, and \( K_h \) represents the \( h \)th cooperative;
I: the number of agricultural machinery under the same type of agricultural machinery, \( i \) is used to represent the number of the \( i \)th agricultural machinery under this type;
\( N_h \): indicates the total number of agricultural machinery in the \( h \)th cooperative;
\( S_j \): the work area that needs to be completed in the \( j \)th operation field, \( j \) represents the \( j \)th operation field;
\( Q_i \): the operational capability of the \( i \)th agricultural machine;
\( D_{(m,j)} \): the driving distance from the starting point \( m \) to the operation field \( j \);
\( V_{(m,j)} \): the average speed of driving from the starting point \( m \) to the working field \( j \);
\( T_{(m,j)} \): travel time from starting point \( m \) to field \( j \):
\[
T_{(m,j)} = \frac{D_{(m,j)}}{V_{(m,j)}}
\]  
\( x_i \): the \( i \)th agricultural machine allocated from \( j \) cooperative;
\( W_i \): the time is delayed due to failure of the agricultural machinery \( i \) while driving;
\( A_{(m,j)} \): the time from the starting point \( m \) to the operation field \( j \) is recorded as the time when the agricultural machinery starts to work;
\( E_j \): indicates the end time of completing the work in the work field \( j \);
\( C \): indicates the time that the agricultural machinery is affected by external factors such as weather and roads when driving;

Other constraints are as follows:
Each field is limited to one agricultural machine to serve:
\[
\sum_{i=1}^{I} x_{ij} = 1, \quad j = 1, 2, \ldots, n, \quad i \in N_h, \quad h = 1, 2, \ldots, n.
\]  

Whether to assign agricultural machinery to work:
\[
x_{ij} = \begin{cases} 
1, & \text{Assign No.}I \text{ farm machine to work in field } J, \\
0, & \text{No.}I \text{ farm machine was assigned to field } J.
\end{cases}
\]

The time \( T'_{(m,j)} \) of the agricultural machinery from the starting point \( m \) to the operating point \( j \) is equal to the time when the work ends at the \( j \) point plus the road travel time

---

Table 1: Comparison of objective functions.

| Objective function | Advantage | Shortcoming |
|--------------------|-----------|-------------|
| Short-distance priority | Short waiting time and timely job scheduling | Homework may take longer to complete |
| Short assignments are preferred | Make full use of the existing agricultural machinery resources, and the operation time is short | Waiting time may be longer |
| Short distances and short jobs are preferred | The total service time is the shortest, saving time and cost | May add other costs |

---
Agricultural machinery is operating at point $M$,

$$A_{(m,j)} = \begin{cases} e_m + T_{(m,j)}, & \text{Agricultural machinery is operating at point } M, \\ T_{(m,j)}, & \text{Agricultural machinery has not been operating at point } M \text{ or the operation has been completed}. \end{cases} \quad (4)$$

When the $i$th agricultural machine is working, the end time should be greater than the start time, that is:

$$E_j > A_{(m,j)}. \quad (5)$$

When the $i$th agricultural machine is working, each operation must complete:

$$Q_j x_{ji} (E_j - A_{(m,j)}) = S_j. \quad (6)$$

The objective function (7) is to minimize the operation time:

$$\text{Min} F_1 (x) = \sum_{j=1}^{n} (E_j - A_{(m,j)}). \quad (7)$$

The objective function (8) is to minimize the waiting time for the job, that is, the job start time, and to advance the job start time as much as possible:

$$\text{Min} F_2 (x) = \sum_{j=1}^{n} \sum_{i=1}^{n+h} A_{(m,j)} + \sum_{i=1}^{n} W + C_i. \quad (8)$$

The objective function (9) minimizes the sum of the travel time and operation time of agricultural machinery:

$$\text{Min} F_3 (x) = \sum_{j=1}^{n} \sum_{i=1}^{n+h} A_{(m,j)} + \sum_{i=1}^{n} W + \sum_{j=1}^{n} (E_j - A_{(m,j)}) + C. \quad (9)$$

If the same type of agricultural machinery models that have spared time in different cooperatives can be dispatched, consider the above (8) as the objective function, that is, when the operating time is similar, the shortest road travel time is the goal; If there are two or more different agricultural machinery in a working state that can be dispatched in an operation area, consider the above (7) as the objective function, that is, when the travel time is similar, the shortest operation time is the goal; If there are different models in different locations that can be scheduled, (9) is considered as the objective function, that is, the shortest sum of travel time and operation time is the goal.

4. Results and Analysis

4.1. Prism Verification. The author selects the four cooperatives under investigation as the research objects, and takes the main agricultural machinery type combine harvester as the dispatching research object, the cooperative information is shown in Table 2, since wheat and corn crops are mainly grown, the main harvester models used by the four cooperatives are Lovol Gushen GN70 combine harvester, Kubota 4LZ-2.5 combine harvester, Chery 4LZ-2.0 combine harvester, and Woder Ruliong 4LZ-5.0E combine harvester. Model, after statistics, the cooperative information table is shown in Table 2, and the harvester operation capacity table is shown in Table 3, the table of field locations is shown in Table 4, and the table of distances between cooperatives and fields is shown in Table 5 and Figure 2, in addition, after consultation, it was learned that the speed of the harvester is generally 35 km/h when driving, and the speed in the field is generally 16 km/h.

(1) Using the above model, the calculation is based on the priority of short jobs. The process is as follows.

Determine the working field area; Determine whether there is any agricultural machinery that is not working, and if so, enter the queue; If not, calculate the time required for the agricultural machinery in the working state to complete the job, and enter the queue according to the end time of the job; Enter the agricultural machinery in the queue, find the type of agricultural machinery suitable for the operation field, calculate the operation time of different agricultural machinery, sorting, if the agricultural machinery is in use, the operation time is the sum of the remaining working time of the previous job and the time of the upcoming operation; Select the agricultural machinery with the minimum calculated time for scheduling.

(2) The calculation is carried out with the short-distance priority as the goal, and the algorithm process is as follows.

Determine the working field area; Determine whether there are spare agricultural machinery resources, if so, determine the location of agricultural machinery and enter the queue; If there are no spare agricultural machinery resources, calculate the time required for the agricultural machinery in the working state to complete the operation, and enter the queue according to the length of the operation end time; Calculate the travel time of the agricultural machinery to the work field in the idle state, and sort according to the length of time; If the agricultural machinery is in working state, calculate the remaining work end time, travel time and time, and sort them by size.

By sorting the results, determine the agricultural machinery with the shortest time, and carry out agricultural machinery scheduling; When calculating with the goal of short-term operation priority, the driving time of agricultural machinery is not considered, which may lead to a long waiting time for farmland operations; Similarly, when the short-
distance priority is the goal, the problem that may result is that the operation time of the agricultural machinery is too long. Considering the above problems, by calculating the sum of the travel time and the operation time, and judging the size by sorting, arrange the corresponding agricultural machinery to work.

(3) The calculation process aiming at short distance and short work priority is as follows.

Determine the work field to be arranged;
Determine whether there are spare agricultural machinery resources, if so, enter the queue; If there are no spare agricultural machinery resources, calculate the time required for the agricultural machinery in the working state to complete the operation, and enter the queue according to the end time of the operation;

| Serial number | Machine width (m) | Power (horsepower) | Working power (mu/h) |
|---------------|------------------|-------------------|----------------------|
| M1            | 4.57             | 170               | 9~18                 |
| M2            | 2                | 68                | 3~8                  |
| M3            | 2                | 52                | 2.55~6               |
| M4            | 2.2              | 120               | 8.6~10.8             |

Table 4: Operation field location table.

| Serial number | Latitude and longitude                     | Operating area (mu) |
|---------------|--------------------------------------------|---------------------|
| 1             | 33.0323843981, 115.6757179357               | 80                  |
| 2             | 32.9988743787, 32.988743787                 | 78.5                |
| 3             | 329886210475, 115.6990767266                 | 30                  |
| 4             | 32.9967302832, 115.6518132715                | 26                  |

Table 5: Distance table of cooperatives and operating points.

| Working village number | 1  | 2  | 3  | 4  |
|-----------------------|----|----|----|----|
| Cooperative number    |    |    |    |    |
| K1                    | 12.3 | 19.4 | 15.7 | 17.6 |
| K2                    | 12.9 | 6.3  | 14.3 | 9.3  |
| K3                    | 5.7  | 8.4  | 12.5 | 10.2 |
| K4                    | 11   | 12.2 | 16.3 | 13.9 |

Calculate the travel time from the agricultural machinery in the queue to the field or the sum of the remaining working time and the travel time, and select the agricultural machinery with the shortest sum of time for scheduling;

In the process of model verification, we contacted the relevant staff of the cooperative to give us a scene in the operation of agricultural machinery, the 80 acres of working fields in Fuming Village need to be worked, the manager intends to schedule the M1 model of Laoya Cooperative for operation (because it is familiar with the staff of Laoya Cooperative), and the time required to complete the operation is: 6.27 h. But when we do the calculation, the result is as follows.

If each cooperative has spare agricultural machinery that can be dispatched, the M1 type harvester will be dispatched to Fuming Village for work using short-term operation priority, using short distance, priority will be given to dispatching agricultural machinery of Zhengzhou Cooperative with the shortest waiting time, if short distance and short
Table 6: Scheme comparison table.

| Program                          | Time (h) |
|---------------------------------|----------|
| Laoya cooperative agricultural machinery M1 | 6.28     |
| Zhengzhou cooperative agricultural machinery M1 | 6.12     |

operation are given priority, the M1 model of Zhengzhou Cooperative will be dispatched to work in Fuming Village, travel time and work time can be minimized. The time comparison is shown in Table 6.

As can be seen from the above Table, in the case of agricultural machinery that can be dispatched, if the target is short distance and short operation, the time can be saved by 0.16 h, if the distance is relatively long, the time saved will be more. If all agricultural machinery in the cooperative is in operation, considering the end time of the work and the travel time, the sum of the time required to complete the operation, the existing M1 model works in Changying Village, and the work end time is about 2.5 hours; The M4 and M2 models work in Xuzhuang Village, and the work end time is about 0.5 h; The M3 model works in Jiangtang Village, and the calculation results with different targets are as follows: The M1 type is dispatched first for short-distance work; The M3 type is dispatched first for short-distance work; The M4 type that works in Xuzhuang Village is dispatched with priority for short-distance and short-distance work.

4.2. Regional Agricultural Machinery Overview Module

4.2.1. Module Function. The regional agricultural machinery overview is the supervisory department using the platform, when the supervisory department is scheduling agricultural machinery, they need to know the number of agricultural machinery in the region, and view the agricultural machinery data under different types of agricultural machinery, view data such as the number of agricultural machinery in each district or each town, as well as the information of the person in charge of the enterprise. Therefore, two submodules are designed in the regional agricultural machinery overview module, the regional agricultural machinery module displays information such as the number of agricultural machinery in the region, the number of registered enterprises, and the specific information of production and viewing registered enterprises; The information viewing module counts the contact information of agricultural machinery supervision departments in different cities and counties, by viewing the information, you can facilitate the contact between regulatory departments when scheduling cross-regional jobs.

4.2.2. Area Profile Implementation Methods. The front-end obtains the code of the administrative area where the regulatory department is located, and sends it to the back-end through Ajax technology; Through the administrative area code in the background, query the agricultural machinery information table and user information table in the database; The data in the agricultural machinery information table is counted according to the type of agricultural machinery, and the counted data is returned to the front end in Json format. The front-end calls Echart.js to display the total number of different types of agricultural machinery in the region, the number of companies using the platform, the number of companies in different regions in the region, and the details of companies in each region; Easyui.js displays a list of company information, and displays the company to the regulatory authorities in the form of a list.

4.3. Agricultural Machinery Scheduling Module. The agricultural machinery dispatching module is to provide decision-making for the supervisory department to dispatch agricultural machinery, during the busy season of farming, the supervisory department is required to reasonably dispatch the agricultural machinery. Job distribution in the agricultural machinery scheduling module, the plot information in different places will be displayed in a heat map, and an agricultural machinery resource allocation model will be established at the same time, provide advice on the allocation of agricultural machinery resources to the regulatory authorities, the supervisory department shall, through the number of agricultural machinery in the city and county, the working conditions of agricultural machinery, and the operation heat distribution map, according to the recommended agricultural resource allocation plan, it provides scheduling decision support for regulatory authorities.

4.3.1. Module Function. The job distribution module displays the job distribution of the agricultural machinery in the area on the page in the form of a heat map. According to the display of the heat map, the operation distribution and workload distribution of agricultural machinery can be analyzed, combining the data with the actual model, it can provide users with agricultural machinery resource allocation strategies, and provide scheduling decision support for managers.

4.3.2. Implementation. The front-end first throws the acquired area code to the background, and the background queries the agricultural machinery operation information belonging to the area in the job information Table, including agricultural machinery location information, driving speed, operating plot information, operating power and other information; The background will return the query data, the system will calculate, get the agricultural machinery resource allocation plan under the condition of short distance and short operation target, the front-end calls Baidu map to display the heat map, and recommends the plan to the user; Click on the plot to display the scheduling plan.

5. Conclusion

The author designs an agricultural machinery operation management system based on satellite positioning, the system uses satellite positioning technology and other technologies to realize the functions of agricultural machinery management, operation statistics, real-time
supervision, intelligent scheduling, and social services; the system established the agricultural machinery resource allocation model for the system, and realize to provide users with agricultural machinery scheduling scheme. It clarified the functions of each module of the agricultural machinery operation management system, and carried out the overall structure design. According to the preliminary investigation and reference data, the existing problems in the management of agricultural machinery are clarified, the overall structure of the agricultural machinery operation management system is designed according to the needs of users, at the same time, based on this, the main function modules and database to be realized by the system are designed in detail. The agricultural machinery resource allocation model is established for agricultural machinery operation scheduling, different objective functions are set, the optimal scheduling scheme is recommended for users, the actual agricultural machinery allocation and scheduling problem is analyzed, and the agricultural machinery resource allocation model is established, different objective functions are set, real data are collected, the model is verified, the scheduling scheme in different situations is collected and combined with the system, the best scheduling scheme to users is recommended, and the function of agricultural machinery scheduling is realized. The agricultural machinery operation management system designed by the author uses information technology to carry out information management of agricultural machinery, improves the operation efficiency of agricultural machinery, and reduces the management cost, it has certain reference and practical value for agricultural machinery management. In the establishment of the agricultural machinery resource allocation model, few variables are considered, and only the allocation of agricultural machinery resources is considered, other influencing factors of agricultural machinery scheduling, such as the cost of using agricultural machinery, is not considered. In the later stage, other scheduling-related algorithms will be studied, a more complete model will be established, and more data will be used to obtain a more reasonable and accurate scheduling strategy, which will provide more accurate support for the agricultural machinery scheduling of the regulatory department.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

[1] A. Onumo, I. Ullah-Awan, and A. Cullen, “Assessing the moderating effect of security technologies on employees compliance with cybersecurity control procedures,” ACM Transactions on Management Information Systems, vol. 12, no. 2, pp. 1–29, 2021.

[2] Y. Guo, X. Wang, and C. Wang, “Impact of privacy policy content on perceived effectiveness of privacy policy: the role of vulnerability, benevolence and privacy concern,” Journal of Enterprise Information Management, vol. 35, no. 3, pp. 774–795, 2022.

[3] K. Na, “The effects of cognitive load on query reformulation: mental demand, temporal demand and frustration,” Aslib Journal of Information Management, vol. 73, no. 3, pp. 436–453, 2021.

[4] M. Papadaki, I. Karamitcos, and M. Themistocleous, “View point covid-19 digital test certificates and blockchain,” Journal of Enterprise Information Management, vol. 34, no. 4, pp. 993–1003, 2021.

[5] D. J. Lee, B. Stvilia, and S. Wu, “Toward a metadata model for research information management systems,” Library Hi Tech, vol. 38, no. 3, pp. 577–592, 2018.

[6] X. Pan, C. Han, M. Song, and M. Wang, “The impact of information technology investment on the performance of apparel manufacturing enterprises: based on the moderating effect of equity concentration,” in Proceedings of the IEEE Transactions on Engineering Management, pp. 1–9, IEEE, Piscataway, NJ, USA, 2020.

[7] N. Zhang, T. Shi, H. Zhong, and Y. Guo, “Covid-19 prevention and control public health strategies in Shanghai, China,” Journal of Public Health Management and Practice, vol. 26, no. 4, pp. 334–344, 2020.

[8] Z. Cheng, K. Li, and C. I. Teng, “Understanding the influence of privacy protection functions on continuance usage of push notification service,” Aslib Journal of Information Management, vol. 74, no. 2, pp. 202–224, 2022.

[9] S. Liu, R. Liu, J. Zheng, and X. Liu, “Predictive function control in tertiary level for power flow management of dc microgrid clusters,” Electronics Letters, vol. 56, no. 13, pp. 675–676, 2020.

[10] H. Hajebrahimi, S. M. Kaviri, S. Eren, and A. Bakhshai, “A new energy management control method for energy storage systems in microgrids,” IEEE Transactions on Power Electronics, vol. 35, no. 11, pp. 11612–11624, 2020.

[11] S. Rehman, H. Habib, S. Wang, M. S. Buker, and H. Garni, Optimal Design and Model Predictive Control of Standalone Hres: A Real Case Study for Residential Demand Side Management, IEEE Access, Piscataway, NJ, USA, 2020.

[12] J. Liu, C. Wang, and X. Xiao, “Design and application of science and technology project management information system for educational institutes,” Mobile Information Systems, vol. 2021, no. 10, pp. 1–10, 2021.

[13] Y. Jiang, H. Yu, and J. Jiang, “Optimization of multidimensional clinical information system for schizophrenia,” Complexity, vol. 2021, no. 3, pp. 1–10, 2021.

[14] J. Y. Xue, “On the management of accounting files in public institutions based on informatization,” Journal of Physics: Conference Series, vol. 1533, no. 2, Article ID 022055, 2020.

[15] Q. Hao and L. Qin, The Design of Intelligent Transportation Video Processing System in Big Data Environment, IEEE Access, Piscataway, NJ, USA, 2020.

[16] X. Zhang, B. Zheng, and L. Pan, Using Virtual Reality Technology to Visualize Management of College Assets in the Internet of Things Environment, IEEE Access, Piscataway, NJ, USA, 2020.

[17] S. Chen, T. S. Du, and S. Wang, “Delineating management zones in maize field based on fuzzy c-means algorithm,” Nongye Jixie Xuebao/Transactions of the Chinese Society of Agricultural Machinery, vol. 50, no. 11, pp. 293–300, 2020.
[18] S. Soylu and K. Çarman, “Fuzzy logic based automatic slip control system for agricultural tractors,” *Journal of Terramechanics*, vol. 95, no. 7, pp. 25–32, 2021.

[19] Y. Cao and H. Zhu, “Research on digital information system construction and intelligent management of clinical pediatric nursing in hospital,” *Journal of Medical Imaging and Health Informatics*, vol. 10, no. 4, pp. 898–905, 2020.

[20] X. Yang, L. Shu, J. Chen et al., “A survey on smart agriculture: development modes, technologies, and security and privacy challenges,” *IEEE/CAA Journal of Automatica Sinica*, vol. 8, no. 2, pp. 273–302, 2021.

[21] M. G. O. Askerov, “New materials for the production of replaceable parts of tillage agricultural machinery,” *Bulletin of the National Technical University «KhPI» Series New solutions in Modern Technologies*, vol. 2, pp. 3–8, 2021.

[22] P. E. Coti-Zelati, M. Teixeira, M. M. Machado, D. L. A. D. Araújo, and R. M. D. Pereira, “Perception of the sociology of absences in the agricultural machinery industry supply chain,” *Revista de Economia e Sociologia Rural*, vol. 60, no. 4, pp. 1–19, 2021.

[23] G. S. Smania, G. H. d. S. Mendes, M. Godinho Filho, L. Osiero, P. A. Cauchick-Miguel, and W. Coreynen, “The relationships between digitalization and ecosystem-related capabilities for service innovation in agricultural machinery manufacturers,” *Journal of Cleaner Production*, vol. 343, no. 1, Article ID 130982, 2022.

[24] B. V. Pokidko, V. V. Alisin, M. N. Roshchin, and A. Y. Simakov, “Increasing the service life of lubricants for the lubrication of agricultural machinery and road machinery,” *IOP Conference Series: Earth and Environmental Science*, vol. 839, no. 5, Article ID 052064, 2021.

[25] Y. Chen, W. Zhang, L. Dong, K. Cengiz, and A. Sharma, “Study on vibration and noise influence for optimization of garden mower,” *Nonlinear Engineering*, vol. 10, no. 1, pp. 428–435, 2021.