Research Article

The Promotion of Rural Lodging Development by a Comprehensive Evaluation Model of Artificial Intelligence Based on Wireless Network

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Intelligent scenic planning and management attempt to take advantage of the discipline in the field of artificial intelligence, to explore new roles and models for planning and decision making with the help of machine learning in academic research and to build a complete scenic intelligent management system. Labour costs and energy costs account for a large share of the operating costs of B&Bs. In order to increase revenue while reducing costs and energy losses, this paper designs an unattended intelligent management system for B&Bs. Based on data mining technology, a large amount of B&B operation data is obtained using a crawler program to provide reference to assist B&B business owners in decision making; using wireless RFID technology, the RSSI value of the corresponding tag is read by a reader to detect changes in the location of the human body, making check-in and check-out management more efficient; the driving circuits of lighting, curtains, and air conditioners are controlled by an STM32 control module.

1. Introduction

In the context of building “smart cities” and “smart tourism,” with the call and promotion of artificial intelligence industry by governments and in line with the development of the times and technology, the planning, design, and construction industry of scenic spots, which is one of the core elements of the tourism industry, has first produced the concept of “digital scenic spots” [1]. The concept of “digital scenic spot” is to break through the bottleneck of “digital scenic spot” construction, so as to make better use of big data, mobile Internet, artificial intelligence, and other technical conditions [2].

In terms of China’s long-term development, the natural and humanistic landscapes in the vast country are an important part of the national resources, a precious heritage left by nature and our ancestors, and the planning and construction of scenic spots are of great significance to the country’s cultural heritage, ecological protection, science education, and economic development [3]. Therefore, intelligent scenic planning attempts to give full play to disciplinary advantages in the field of artificial intelligence and explore new rules and models for planning and decision making with the help of machine learning in academic research, which is an inevitable trend in response to national policies and in line with the trend of the times [4].

On this basis, analysing, sorting out, and reviewing the current situation and prospects of the application of artificial intelligence in the planning and management of intelligent scenic areas constitute a guide to the changes in landscape planning and management and are of great significance in promoting the development of the tourism industry, enhancing the scientific nature of scenic planning and management, and promoting the application of technology [5].

With the rapid development of rural tourism, tourists’ demand for the B&Bs and the quality of their services has been increasing, and various types of B&Bs have been emerging. Unlike urban B&Bs, rural B&Bs are mostly
managed by landlords or their families, who are relatively lacking in professional service knowledge [6]. With the introduction of the concept of “smart tourism,” the intelligent management of B&Bs through information technology is a necessary way to create distinctive B&Bs, improve the satisfaction of residents, and respond to the development of the time [7].

To this end, this paper uses machine learning methods to build a B&B merchant assistance system based on data mining technology [8] and innovatively applies wireless RFID (radio frequency identification) [9] technology to the B&B room management system to achieve unmanned and intelligent home automation in B&Bs. The passive RFID tags are deployed in the rooms of the B&B to detect the movement of people in the rooms in real time and determine whether the occupants of the rooms have moved based on the returned RSSI (received signal strength indicator) [10] values. Throughout the detection process, the occupant’s body form is not visualised, ensuring that the occupant’s privacy is not violated. The proposed unattended intelligent management system for B&B aims to realise the unmanned and intelligent management of B&B, save manpower and energy costs while providing a comfortable living environment for the occupants, and enhance the economic benefits of B&B [11].

2. Related Work

In recent years, scholars at home and abroad have done a lot of related work on B&B management systems; for example, [12] proposed a gesture interaction method based on the cyber-physical environment to solve the problem of personalised gesture recognition in the smart home environment; [13] conducted research and analysis on the security of smart homes and proposed a new privacy protection mechanism; [14] proposed a context-aware service execution method and built a smart home prototype system; [15] studied the hidden conflicts that occur in smart home scenario linkage and proposed a new detection method for its better automated service delivery. The intelligence of service, management, and marketing can all promote B&B operations, with the impact of intelligent management systems on B&B operations being the most significant [16], but intelligent management systems for B&Bs have not yet been widely used [17], and most B&B merchants are still at the preliminary stage of understanding intelligent B&Bs and are unable to truly realise intelligent management of B&Bs.

With the support of the development policies of smart cities and smart scenic spots, the collection and application of big data have been launched in urban planning and scenic spot planning and management, more commonly through QR codes, sensors, and RFID to realise the analysis of spatiotemporal data of scenic spots and provide corresponding data support for scenic spot management and services [18]. A newer way of data collection and processing in China is to use data from commercial taxi or online taxi platforms for travel simulation and direction determination [19]. In terms of big data applications, the emphasis is still more on traditional mathematical and statistical analysis of big data government applications and planning design. There are methodological innovations in big data analysis-assisted planning and design such as distributed big data planning methods, adaptive big data spatial analysis models, and big data dynamic monitoring of urban planning assessment [20].

Big data collection, statistics, and computing methods have been relatively mature; in addition, intelligent scenic planning and decision making still need to increase the data collection framework research for attractions and tourists, database index system research, database index correlation, and growth research [21]. The existing two-dimensional code collection requires the cooperation of tourists, and sensor collection requires high-precision identification equipment, which can provide support for scenic spot management and services, but still needs to be improved to a more convenient and accurate way such as smart bracelet before it can provide more powerful data support for scenic spot planning: big data-assisted analysis of urban planning such as vehicle path simulation prediction through big data in the city can provide analysis of scenic spots and roads. However, due to the special elements of scenic ecology and visitor behaviour and considering the long-term nature of spatial and temporal changes in scenic areas, the full participation of landscape architecture professionals is still needed.

Artificial intelligence and machine learning started early in planning management, but the classical algorithms such as meta-cellular automata and wise bodies proposed in the 1980s have significant limitations in terms of kernel, number of variables, and complexity of boundary conditions for decision simulation [22]. In order to obtain further improvements in simulation capabilities, parallelised computing represented by the PARAMICS system and VISSIM system is the common technical route nowadays. The parallelised efficiency enhancement of urban land use simulation based on meta-cellular automata and its application in regional planning have also become a hot topic of academic discussion. Architectural design focuses on AI-enriched architectural design. Combined with virtual reality applications of artificial intelligence, there are studies on planning and design management applications, disaster space identification, planning and design text mining, and convolutional neural networks for urban element interpretation and so on [23].

3. Overall Design Framework

The B&B unattended intelligent management system consists of two main components: the merchant assistance system and the room management system. The merchant assistance system analyses data from major B&B booking websites crawled by a crawler program to provide B&B merchants with reference for price prediction and other auxiliary decisions; the room management system uses an RFID detection system and an STM32 control module to achieve check-in management, check-out management, and
smart home management. The overall design framework of the B&B unattended intelligent management system is shown in Figure 1.

4. B&B Merchant Assistance System

4.1. B&B Data Mining. A crawler was used to crawl a large amount of B&B data, including the name, location, room type, user reviews, and special offers of B&Bs, from major popular travel and group-buying websites, such as Ctrip, Go.com, and Meituan.com. The crawler in the merchant assistance system was developed using the Scrapy framework, a high-level web data crawling framework in Python with customisable crawling content [24], to quickly crawl the data required by merchants. The workflow of the crawler in the merchant assistance system is as follows.

1. Enter the URL of the data required by the merchant, and then call request to send a data request
2. Send the URL of the data resource to the downloader via the engine using the scheduler in the Scrapy framework
3. The downloader receives the request, fetches the data in the corresponding URL, and returns it to the engine, which then returns the data to the crawler and extracts the corresponding content through the XPath syntax
4. The extracted data enters the data queue and is finally stored in the MySQL database created

Use the written crawler to crawl the data from the B&B booking interface on popular travel and group-buying websites and store it in the MySQL database.

The crawled data was sorted into the Ctrip table in the MySQL database according to the data format shown in Table 1, with the data arranged in the following order: serial number, B&B name and description, B&B label, B&B rating and area, real-time price and special offers, etc.

Build a database of B&B information based on the contents of the Ctrip tables, which merchants can use to compare other B&Bs side-by-side in order to position and price their B&Bs appropriately.

4.2. Data Analysis and Price Forecasts. By analysing the crawled B&B data (e.g., B&B name, area, real-time prices, special offers, user reviews, and rating parameters), the characteristics of different B&Bs and their price fluctuation patterns can be obtained. Merchants can position their B&Bs correctly and improve their services and facilities based on user reviews and ratings. By comparing the prices of B&Bs on different dates, merchants can forecast the prices of B&Bs on weekdays, weekends, and holidays and make reasonable pricing for their own B&Bs, taking into account their own operating costs and service conditions, enabling dynamic price adjustments.

5. B&B Room Management System

5.1. RFID Inspection Systems. Wireless RFID technology has the advantages of low cost, contactless, and automatic fast identification [25] and is widely used in manufacturing and daily life, such as food traceability, intelligent workshop association, and vehicle positioning [26]. RFID tags are extremely hazardous to the human body, being almost negligible, so the use of RFID technology to detect people in the room has a high level of safety; for example, in [8], RFID technology is applied to the tracking and positioning of livestock breeding process and indoor human positioning.

The B&B room management system in this paper uses RFID technology to detect the presence of people in a room without making the human form visible, thus protecting the privacy of the occupants. Even if the data are compromised, without a trained machine learning algorithm model, the data is of no practical value and the occupants’ privacy remains intact.

In the B&B room management system, when the door is opened, the RFID detection system in the room starts to work: if the resident enters the room during normal check-in hours, the RFID detection system sends the “correct” command to the B&B backend server, which controls the smart home control system in the room to start working; if entry is detected during nonnormal check-in hours, the RFID detection system will send an “error” command to the B&B back office server to notify the administrator to carry out a security check.

The RFID detection system consists of passive RFID tags, RFID antennas, RFID readers, STM32 control modules, etc. The block diagram is shown in Figure 2. The RFID detection system is installed using UHF RFID devices because the reading and writing distances of low and medium frequency RFID devices are relatively short and are not suitable for detecting personnel changes in the room. The detection principle of UHF RFID equipment is shown in Figure 3. The RFID detection system works as follows.

1. RFID antennas and passive RFID tags are laid on the walls of the room. Under the control of the STM32 control module, the RFID antennas receive the RSSI values returned by the passive RFID tags in the room at a set time.
2. Passive RFID tags are placed on one of the walls in the room. Given that the detection target is generally no more than 2 m in height, the economy and reasonableness of the integrated, passive RFID tags are placed at the beginning of the wall 0.5 m from the ground, with a maximum placement height of 2 m. The length of the placement is equal to the length of the wall, and the spacing of the placement is equal to the operating wavelength of the UHF RFID device.

Let the length of the wall be $l$, the height be $h$, the area be $S$, the wavelength of the UHF RFID device used be $\lambda$, and the number of passive RFID tags be $m$: 
Take a room with an area of 40 m² as an example; the length of one wall is about 5 m, the height is about 3 m, and the area is about 15 m²; the spacing of passive RFID tags (0.32 m) is set according to the operating wavelength of the UHF RFID equipment used, and the number of passive RFID tags to be deployed in the room is calculated to be about 60.

(3) When someone enters the room, the RSSI value received by the RFID antenna changes due to the blockage of the human body. The RFID reader will
process the collected RSSI value and transmit it to the
STM32 control module through the serial port
according to a specific format.
(4) The STM32 control module processes the data
collected by the RFID reader, extracts the RSSI value,
and transmits it to the B&B backend server.
(5) The B&B backend server analyses the RSSI values in
different environments in order to control the smart
home devices in the room.

The RFID detection system in this paper uses 16 passive
RFID tags. When an occupant enters a room with passive
RFID tags, the RSSI value received by the RFID antenna
changes. To make it easier to see if the room is occupied, the
room is marked in the data sheet, where "0" means no one
is in the room and "1" means someone is in the room. As
shown in Figure 4, the RSSI values collected by the RFID
reader are different when the room is occupied and un-
occupied. Once the RSSI value is received by the B&B
backend server, the RSSI value can be processed by the
SVM (support vector machine) algorithm to determine
whether the room is occupied or not, and the signal can be
transmitted to the STM32 control module for smart home
device control.

The core of the SVM [27] is to find a decision boundary
(hyperplane) that maximises the separation between the 2
separated categories in order to classify the dataset with
higher confidence. \( n \)-dimensional Euclidean space of the
hyperplane can be determined by the following equation:

\[
w^T x + b = 0,\]

where \( w \) and \( x \) are both \( n \)-dimensional column vectors,
where \( x = [x_1, x_2, \ldots, x_n]^T \) is the point on the hyperplane,
\( w = [w_1, w_2, \ldots, w_n]^T \) is the normal vector to the hyper-
plane, and \( w \) determines the direction of the hyperplane; \( b \) is
the distance from the hyperplane to the origin.

When the margin of the decision boundary is the largest,
the classification has a high degree of confidence; otherwise,
any small change will have a great impact on the classifi-
cation of the dataset. In this case, the SVM model has a good
training effect, but the prediction effect is poor, resulting in
the phenomenon of "overfitting." The larger the margin, the
better.

In order to maximise the margins of the decision
boundary, the linear SVM learning algorithm is used to
process the data collected by the RFID detection system.

The input to the linear SVM learning algorithm is the
training set \( T = \{(x_1, y_1), (x_2, y_2), \ldots, (x_N, y_N)\} \), where
\( x_i \in \mathbb{R}, y_i \in \{1, 0\}, i = 1, 2, \ldots, N \).

The output of the linear SVM learning algorithm is a split
hyperplane and a classification decision function. Choose
the penalty parameter \( C > 0 \), and construct and solve the
convex quadratic programming problem

\[
\min \left\{ \frac{1}{2} \sum_{i=1}^{N} \sum_{j=1}^{N} \alpha_i \alpha_j y_i y_j (x_i \cdot x_j) - \sum_{i=1}^{N} \alpha_i, \text{s.t.} \sum_{i=1}^{N} \alpha_i y_i = 0, \quad 0 \leq \alpha_i \leq C. \right\}
\]

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\]

5.2. Smart Home Control System. When the RSSI value
is received by the B&B backend server, the data is analysed by a
linear SVM learning algorithm to determine if the room is
occupied; if so, the signal is sent back to the STM32 control
module, which controls the smart home devices in the room
in real time. The smart home control system in this paper
consists of a main controller and various functional modules
(light-sensing and temperature-sensing modules), the
hardware structure of which is shown in Figure 5. The main
controller consists of an STM32 control module, a lighting
circuit, a controller, a lighting driver circuit, and an air condi-
tioning driver circuit. When the user manually controls the
smart home control system via the smart touch panel, the
STM32 control module controls the lighting module
and temperature-sensing module according to user
commands.

5.3. Check-Out Management. The room management sys-
tem will send check-in time as well as check-out time to the
resident after successful booking and detect the

(1) If the resident submits a check-out request before the
check-out time, the RFID detection system will be
activated after the check-out request is submitted,
and after confirming that no one is in the room, the
housekeeping staff will be notified to clean the room.
(2) If the resident does not submit a check-out applica-
tion, the RFID detection system will be activated
after the check-out time comes.
① If the resident has left the room, the house-
keeping staff will be notified to clean the room.
② If the resident is still in the room, the resident
will be alerted by voice through the voice control
system in the room that the check-out time is up,
and 10 minutes will be reserved for the resident to
pack and leave the room.
③ After 10 minutes, the RFID detection system is
activated again, and if the resident has left the room,
the housekeeping staff will be informed to clean
the room; if the resident is still in the room, the resident
will be reminded again by voice and the water and
electricity will be disconnected from the room [28,29].
6. Experiment

The combination of artificial intelligence and machine learning with architecture, urban planning, and landscape architecture is an inevitable trend in the development of information and the progress of the discipline, and as far as we can see, the specialisation and independence of each field are still strong. Artificial intelligence and machine learning are mostly the expertise of the computer field and are not applicable to complex and vivid human spatial decisions only through the simple application of scenarios to urban and scenic environments. If suitable computing methods and application models can be selected and trained with assistance, more progress may be made in the scenic planning paradigm, planning efficiency, accuracy, and scientificity of planning results, as shown in Figure 7.

From the above analysis, it can be seen that at present the field of intelligent scenic areas and machine learning is still mostly qualitative research, with artificial intelligence research content mainly focusing on geospatial identification and scenic area operation and management on the branch areas, mostly transplantation of research technology in related fields. As shown in Table 2, the results are scattered when different parameters are set, and there is a lack of horizontal and vertical comparative analysis, especially for systematic research on planning and design techniques and
planning and design decisions. Various types of analytical models and learning models have been established in the fields of urban planning and architecture for artificial intelligence and machine learning in the areas of traffic systems, land use, architectural design, use analysis, and spatial recognition.

From the perspective of research fields, the research of each discipline is relatively independent, each playing its own disciplinary strengths. Although there is crossover in the fields of computers, urban and rural planning, landscape architecture, tourism, geography, management, economics, etc., there is a lack of systematic research. If we want to achieve machine-learning-guided program-assisted decision making in scenic planning and management, as shown in Figure 8, the comprehensive intervention of landscape architecture is inevitably needed, as well as the traditional human brain joint collaboration between planning and computer simulation, with a gradual transition to unsupervised learning after the implementation of supervised learning from machine learning.

In terms of research content, in the field of combining landscape gardening and machine learning, although many useful attempts have been made in the areas of data mining, spatial analysis, and management and operation for “attraction-path" planning for smart lodges, as shown in Figure 9, less research has been conducted directly on scenic
planning and management, and there is a lack of research that systematically considers attraction selection and path planning. At the same time, most of the research related to attraction and path planning decisions is based on sub-research in tourism planning and scenic planning, being mostly qualitative, while quantitative research also incorporates more subjective factors, requiring a more objective and quantitative summary of the decision rules to ensure the applicability of the research at more intelligent scenic planning levels as shown in Table 3.

**Table 2: Experimental parameter settings.**

| Parameter setting | $t_{max}$ | $M$ | $L$ | $P_m$ | $P_c$ |
|-------------------|-----------|-----|-----|-------|-------|
| Parameter value   | 12        | 26  | 13  | 0.45  | 0.79  |

**Figure 7:** Five star result radar map.

**Figure 8:** Time domain distribution of data encryption.
However, the planning of scenic areas often involves the growth and evolution of natural and human resources over a long historical period, and the behaviour of tourists is not limited to the time of entry to the B&B, but there are often multiple visitors, and their behaviour at different times will have an impact on the planning of "attractions-trails." The different size of the area will also lead to a diversity of visitor behaviour (selection of attractions, paths, length of stay, etc.).

7. Conclusions

The unattended intelligent management system of B&B proposed in this paper can provide reference to assist B&B merchants’ decision making by mining B&B data through a crawler program; the reasonable use of wireless RFID technology realises unattended management of B&B; by using linear SVM learning algorithm, the accuracy rate of RFID detection system reaches 99.25%, which has high practicality. The unattended intelligent management system of the B&B responds to the national strategy of revitalising the countryside with intelligent electricity services, provides users with high quality services, and saves energy.

Data Availability

The datasets used during the current study are available from the author on reasonable request.

Conflicts of Interest

The author declares that he has no conflicts of interest.

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