



Design of Hotel Marketing Information Management Model Based on Deep Learning

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Abstract. The traditional information management model has poor data transmission efficiency in the process of pushing information services. To solve this problem, this paper designs a hotel marketing information management model based on deep learning. Using Oracle relational database and MVC architecture to build a marketing information database, then use deep learning to extract information features, and classify marketing information of different service categories, connect hotel management and client, and integrate model management functions to provide information services for hotel managers and customers. The experimental results show that the data throughput and transmission rate of the above model are higher than those of the traditional model, and the information transmission efficiency is improved.

Keywords: Deep learning · Hotel marketing · Information management · Information extraction · Marketing information database

1 Introduction

At present, hotel information management is widely used in hotel operations, digitizing and standardizing the hotel's customer service, material movement, transaction processing, cash flow, customer interaction and other business processes, enabling the hotel to manage both internally and externally. Significant changes have taken place in all aspects. Therefore, the research on the hotel marketing information management model has important practical significance [1].

American scholars put forward 4R Theory, using network technology and resources to carry out network relationship marketing through information communication, so as to grasp the two basic strategies of establishing customer files and improving after-sales service network, so as to achieve a larger range of customized marketing. Domestic scholars analyze the theory of "six market model", and think that the relationship marketing of enterprises mainly includes employee relationship marketing strategy, customer relationship marketing strategy, partner relationship marketing strategy, and influencer relationship marketing strategy. Among them, employee relationship marketing strategy is the basis of relationship marketing, customer relationship marketing strategy is the

core and destination of relationship marketing, and then the corresponding marketing strategy is formulated for each related object.

Based on the above points of view, the formulation of relationship marketing strategies should have certain conditions and be carried out step by step. The relationship is maintained and consolidated around the mutually beneficial exchange relationship between related parties, and the use of network information technology to establish customer files and improve file management. On the basis of this theory, this research designs a hotel marketing information management model based on deep learning. The model first uses Oracle relational database and MVC architecture to build marketing information database, then uses deep learning to extract information features, classifies marketing information of different service categories, connects hotel management end and client, and integrates model management functions, so as to provide information services for hotel managers and customers. This study also proves that the model has the advantages of high data throughput and transmission rate through experiments.

2 Design of Hotel Marketing Information Management Model Based on Deep Learning

2.1 Build a Hotel Marketing Information Database

2.1.1 Building Management Model Organizational Structure

Use the classic MVC model and oracle relational database to construct the hotel marketing information database. The full name of the MVC architecture is Model View Controller. This architecture pattern processes business data according to the process, and scientifically divides data input, processing, and display output into three layers, corresponding to the model layer, the view layer and the control layer [2]. The view layer is the interface layer that directly interacts with the user. The model layer is in the application of the B/S architecture. The black box operates the data requested by the user. The user in the view layer cannot know the specific operation, but can only see the data processing result. The control layer is the intermediate interaction layer between the first two. It receives data processing requests from users in the view layer and forwards them to the model layer. After the processing is completed, the data is forwarded back to the view layer. This can isolate users and internal operations. To optimize the safety of the model. The organizational relationship of the scientific planning of the MVC architecture is shown in Fig. 1.

On this basis, J2EE is used to construct a relatively complete application component technology framework, and business information created based on core tasks is migrated to the environment provided by Java, thus simplifying the difficulty of multi-level enterprise development and overcoming many user needs Change, resulting in increased delivery time [3]. This completes the construction of the management model organizational structure.

2.1.2 Building Marketing Information Base

On the basis of the design of the model architecture, the Oracl database is used to build a marketing information database. When managers need to manage a large amount of

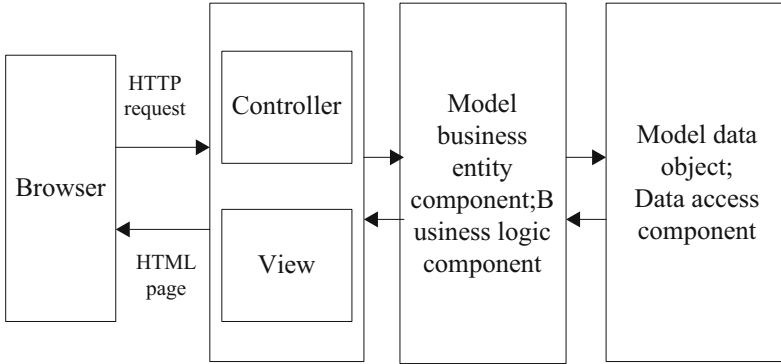


Fig. 1. Organization diagram of model architecture

data, Oracle database can be used. Oracle database is a typical representative of database technology. It has obvious advantages over other databases in many aspects. It is divided into two parts: server and client. When the hotel manager operates the database, he needs to connect to the server and use the database as a local database. When managers use the database for information access, use the database chain to provide support [4].

Oracle database adopts the logic of object relation, which has the characteristics of prudence and authenticity. It not only meets the traditional relational model, but also supports the object mechanism. It can not only solve the table problem, but also meet the other data types provided by various development tools, such as graphics, video, etc., which is helpful for managers to match Oracle database with software products used by hotels. At the same time, Oracle database adds the function of automatic backup and recovery, enhances the operation parallelism of SQL statements, provides practical data partition function, large table, and small block index for information management [5]. The design fields of the information base are shown in Table 1.

Oracle has different server components, storage marketing information can meet the communication of multiple servers, manage the Oracle connection on these servers, and provide users with higher quality images and sound. Oracle database can also manage the text, structured the unstructured data, strengthen the parallel processing function of the database, and divide a query into several subqueries. When managers use computers with multiple CPUs, they can perform operations on different CPUs to improve the business volume of information management and improve the performance of marketing information database.

So far, the construction of hotel marketing information database is completed.

2.2 Classification of Marketing Information Based on Deep Learning

2.2.1 Preprocessing Hotel Marketing Information

This research uses the neural network in deep learning to classify the marketing information in the information database. First, the original marketing information must be pre-processed, including text segmentation and stop-word removal. The words, words and phrases in the information text appear continuously without obvious segmentation

Table 1. Field format of hotel marketing information database

| Field name | Data type | Length |
|--------------------------|----------------|--------|
| User ID | Character type | 8 |
| Username | Character type | 20 |
| User password | Character type | 20 |
| User category | Character type | 20 |
| User status | Character type | 4 |
| Room ID | Character type | 6 |
| Room type | Character type | 6 |
| Maximum number of people | Float | 6 |
| Room price | Int | 8 |
| Discount | Int | 8 |
| Discount | Int | 4 |
| Check in time | Data | 8 |
| End time | Data | 8 |
| Registration time | Data | 8 |

marks, and words, as the basic semantic unit, need to express the characteristics of the information text, so the jieba word segmentation tool is used to segment the information text [6]. Then remove the content that has no practical meaning but a higher frequency in the information text. Because these contents cannot represent the text type, they are of no value to the text classification task, but will increase the dimension of the text feature vector and affect the final effect of text classification. This process allows the remaining text information to better express text characteristics.

Based on this, the word vector method is used to represent the text content. Word vector can map every word in the text to a low latitude space, so that each feature word in the text is represented by the same space, instead of using an independent dimension in the vector space model, so that the high-dimensional sparse vector can be transformed into a low-dimensional real number vector [7]. Compared with the traditional information management model, in the mapped low latitude text feature space, the position relationship of different text feature words corresponding to the word vector represents the association of marketing information at the text semantic level, which can provide more abundant text semantic information. Word2vec can be used to train and generate word vectors. It is a tool based on deep learning, which can easily train a large number of corpus, and can efficiently map the feature words in the text in space to form low latitude dense vector.

So far, the preprocessing of hotel marketing information is completed.

2.2.2 Extracting Information Features Based on Deep Learning

Extract text features from the pre-processed marketing information to realize the classified management of marketing information.

Deep learning is a new field in machine learning research. The model essentially has a hidden layer and a perceptual layer. There are nonlinear data processing modules between each layer. The hidden layer and the perceptual layer perform feature learning and feature transformation on information data., Making the data characteristics from low-level to high-level become more and more abstract. Finally, the extraction of data features is completed in a high abstract level, and the essential features of the data are mined, and the essential features of these data are used to realize the classification of marketing information [8]. The basic structure of deep learning classification information is shown in Fig. 2.

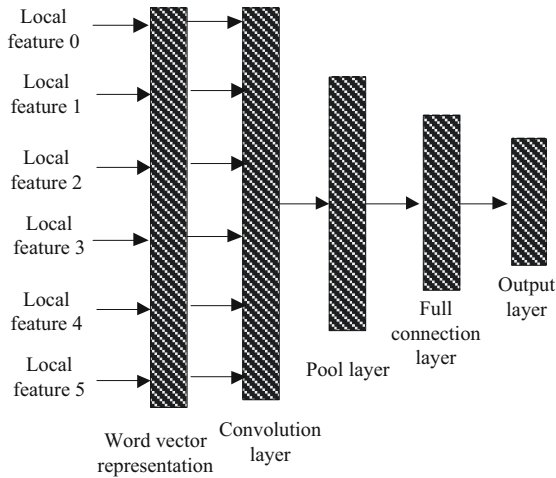


Fig. 2. Neural learning classification process

As shown in Fig. 2, the first half is the input layer, and the middle part is composed of a number of convolutional layers and pooling layers alternately passed, that is, a convolutional layer is connected to a pooling layer, and then a convolutional layer is connected. The half is composed of a fully connected layer and an output layer. The convolutional layer can extract different local features of the input marketing information, and the low-level convolutional layer can extract low-level features of the text, such as words, phrases, phrases, sentences, etc. The high-level convolutional layer can extract high-level features of the text, such as paragraphs and semantics. After the convolutional layer is the pooling layer, the pooling layer can merge semantically similar text features to play the role of secondary feature extraction. After the alternate connection of the convolutional layer and the pooling layer is the fully connected layer, various local text features extracted by the convolutional layer and the pooling layer are summarized and classified, and finally the classified marketing information is obtained through the output layer.

Deep learning can extract higher-level and more abstract text features through the accumulation of convolution layer and pooling layer, which makes the text features have stronger expression ability and more accurately reflect the essential characteristics of the text.

So far, the classification of management information is completed based on deep learning.

2.3 Integrated Hotel Marketing Information

After classifying the information, the association between all kinds of information is established, so that the information can be structured and integrated. The internal and external information stored in the server should be described based on the customer's staying in the hotel, and then the stored information can be dynamically managed by using the attribute characteristics of information resources. On this basis, capture the storage information that needs to be managed and locate it.

Firstly, regular expressions are used to match all the strings of the stored information on the server, and a single string is used to describe the specific matching rules, and the strings generated by different stored information are automatically processed through scripts and meet the syntactic rules [9]. Then use the CSS selector to convert the information string into a CSS style, obtain the specific categories of internal and external information, including information attributes, tags and element combinations, and generate a candidate list for pushing content, and then use XPath to select the data in the CSS style Nodes are used to automatically generate information element nodes through scripts, and then select text nodes and attribute nodes to modify the generated nodes. Then the information element nodes are divided by two writing methods of absolute path and relative path, and XPath is used to define rules, and the information node set is expressed by XPath expression. When capturing dynamic information, it needs to be dynamically acquired from the server side. JavaScript code is executed during the crawling process to realize the rendering of information data, and the behavior of the WeChat client is simulated on the server side to obtain complete dynamic push information. Automatically open the push information through the script, extract the open source browser engine, and directly call the relevant interface of the browser engine, thereby optimizing the rendering parameters of the data node, improving the dynamic data rendering performance, and then extracting the dynamic information node set.

After completing the connection between the management end and the client, the same way is used to wave hands four times. The client sets the field in the packet to 1 as a request to close the connection. After receiving the data packet from the client, the manager will change the connection into a semi closed state, send a fin field to the client actively, and the client will receive the fin field and send the packet again to close the server connection. The integration of information node set and dynamic information node set completes the integration of hotel marketing information.

2.4 Connect Hotel Management and Client

On the basis of marketing information integration, the location of information in information inventory documents is located, and the hotel management end and client are

connected. The websocket interface and connection interface are selected as the external call interfaces of the management end and the client respectively. The function modules are shown in Table 2.

Table 2. Hotel management terminal and client calling interface

| Block name | Interface name | Interface usage |
|--------------------|-----------------|--|
| Connection modular | FrameConnection | Processing information connection related business |
| | Connection | Processing information connection frame and related services |
| WebSocket modular | OnFrame | Notify connection to close |
| | WebSocket | Notify users to receive push messages |
| | OnBinaryMessage | Notification connection open |
| | OnControl | Notify users to receive frame level messages |
| | OnTextMessage | Notify users to receive text messages |

As shown in Table 2, websocket interface is used as the general interface between the connection management end and the client. According to the different types of marketing information, the sending and receiving process of the two interfaces to process messages is defined. The server initiates synchronous serial number message and sends connection request to the client by connecting two interfaces by three handshakes and four waves. Then, according to the MPTCP protocol supported by the client, reply the confirmation character to the server, enable the server to open the relevant functions of MPTCP protocol and send the verification information. At this time, the client directly ignores the fields in the message, making the websocket interface and connection interface establish MPTCP connection [10].

On this basis, the validity of the connection subflow is verified. Send a space between the two interfaces to determine whether the MPTCP connection is valid. When the MPTCP connection is valid, the relevant properties of the connection, including domain name and IP address, are obtained. Then the client sends a packet, uses token encryption to verify the relevant attributes of the connection, and establishes a new connection subflow, which is added to the MPTCP connection, and distinguishes the new subflow according to the IP address.

Because the hotel management end and the client side have established multiple connection subflows, the congestion of each connection path is calculated, the optimal transmission path of information push is selected, each MPTCP connection is regarded as multiple TCP connections, and the transmission throughput of different connection paths is obtained on the basis of certain path bandwidth. The throughput requirement Q of information push is as follows:

$$Q = \frac{\beta}{TW} \sqrt{\frac{2}{p}} \quad (1)$$

In Formula (1), T is the round-trip time of the information connection path, W is the throughput ratio of the sub-stream path, p is the packet loss rate of the push path, and β is the weight of the packet loss rate. Use Formula (1) to filter multiple sub-flow paths, remove the connection paths that do not meet the throughput requirement Q , and then conduct an in-depth analysis of the congestion status of the remaining paths to ensure that the connection path has enough intermediate buffers, and use the minimum RTT algorithm to select appropriate data scheduling strategy. The definition formula of the remaining connection path congestion is:

$$R = \frac{U}{A} \quad (2)$$

In Formula (2), R is the index to judge the congestion of the connection path, U is the congestion window size of the current path, and A is the number of packets on multiple connection paths that have not been confirmed by the client. The larger the R is, the more congested the path is, and packet loss may occur during the information push process. Using Formula (2), the congestion state of each connection path is compared, and the connection path with minimum R value is selected. The information node set is distributed to the optimal connection path according to the proportion, the data round-trip delay parameters are updated, the data round-trip delay is smoothed, and the smoothing factor is weighted to obtain the shortest information connection delay. So far, the connection between the hotel management end and the client is completed.

2.5 Integrated Model Marketing Information Management Function

After connecting the hotel management terminal and the client terminal, it pushes marketing information to provide customers with information services. On this basis, the service functions are integrated. The core functions of the model include customer information and points management functions, front desk business and shift management functions, online query and reservation functions, guest room configuration management functions, user management functions, reports and background management functions. Among them, customer information management functions are mainly divided into online registration and entry functions, customer identity verification and management functions, account information management functions, grade points and discount management functions; the main business functions of the front desk include customer status inquiry, check-in information registration, Settlement processing, check-out information registration, and shift work also involves the transfer of shift records, abnormal situation reporting information processing; online query provides hotel room status information query, and online reservations, so that customers can query hotel operations without logging in The occupancy status of the room, the reservation status in the future, and the discounted price of the room. During the reservation process, customers log in through their member accounts, and then select the confirmed room number, reservation time and period, and submit the booking application. After receiving the application, the model first determines the reservation conditions. If the reservation application cannot be met, it will automatically feed back to the customer the reservation failure and the reasons; if the reservation conditions are met, the model will remind the front desk staff to confirm by phone. Guest room configuration management mainly includes room number setting

and management, room access card or key management, room type and price setting, room goods management; user management includes user account information addition, deletion, information change, account locking, permission setting and change, etc.; the design of background management function module is relatively simple, including report format category setting and report form Sub functions of generating, setting and generating statistical charts.

So far, the integration of marketing information management functions is completed, and the design of hotel marketing information management model based on deep learning is realized.

3 Experiment and Analysis

In order to verify the effectiveness of the hotel marketing information management model based on deep learning, the following comparative experiments are designed. This paper takes the model as experimental group A, two traditional marketing information management models as experimental group B and experimental group C, and completes the performance comparison with this model.

3.1 Experimental Preparation

Select a hotel as the test subject. The hotel receives an average of 7.5 million staying customers annually. Through field surveys and network information collection, the hotel's pricing system is obtained. The specific content is shown in Table 3.

Table 3. Current situation of hotel marketing

| Room type | Number of rooms | Sales price (yuan/day) |
|------------------------|-----------------|------------------------|
| VIP room | 72 | 5800 |
| View room | 160 | 5900 |
| Deluxe view room | 28 | 5900 |
| Sea view room | 56 | 5999 |
| Deluxe sea view room | 95 | 5999 |
| Poolside room | 16 | 5999 |
| Full sea view room | 32 | 5999 |
| Harbour room | 68 | 5999 |
| Ocean view room | 71 | 5999 |
| Superior sea view room | 79 | 5999 |

The hotel network topology is shown in Fig. 3.

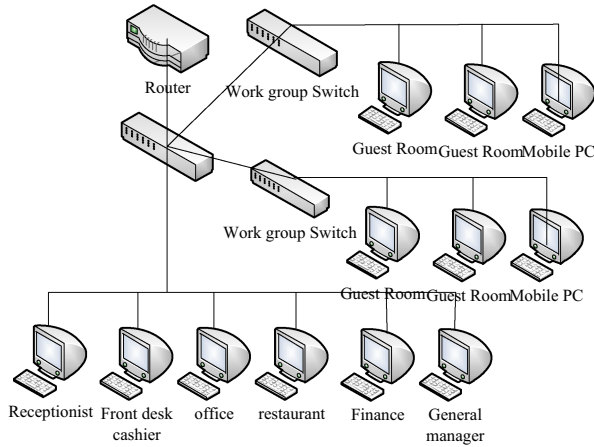


Fig. 3. Hotel network topology

In the hotel network topology shown in Fig. 3, the information management model is deployed. On the basis of the network topology structure, the corresponding web application server, database server and firewall and other hardware equipment are added to provide users with the operation based on Web mode through the internal network and external Internet network.

Three groups of models are used to provide the hotel’s information services, and the objects include hotel customers, general hotel staff, hotel senior managers, and model managers. Combining the hotel services, the service functions provided by different models are shown in Fig. 4.

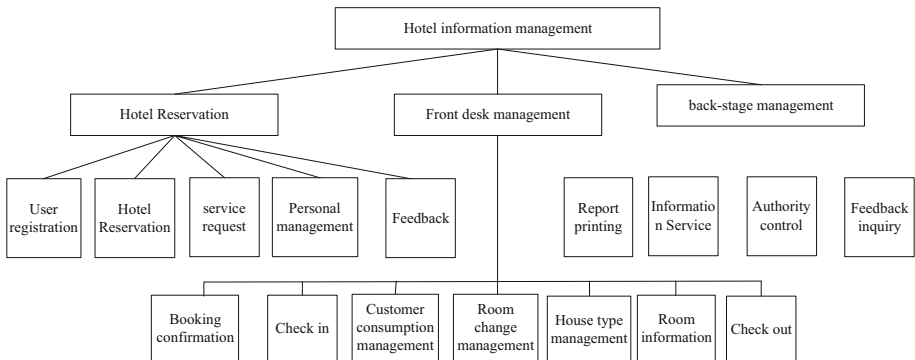


Fig. 4. Functional diagram of marketing information management

3.2 Experimental Results

3.2.1 The First Set of Experimental Results

Push marketing information to service objects. A total of more than 50000 text messages are set, and the login users of the client are 100. Three groups of experiments conduct interactive tests on 100 users. After the test is successful, the service information is pushed in real time. The data throughput of the information push service was compared among the three groups of experiments. The experimental results are shown in Table 4.

Table 4. Comparison results of the first group of experiments

| Information push time (s) | Group A data throughput (Mbps) | Group B data throughput (Mbps) | Group C data throughput (Mbps) |
|---------------------------|--------------------------------|--------------------------------|--------------------------------|
| 10 | 1.1 | 1.1 | 1.1 |
| 20 | 1.3 | 1.1 | 1.1 |
| 30 | 1.4 | 1.2 | 1.1 |
| 40 | 1.5 | 1.4 | 1.2 |
| 50 | 1.7 | 1.4 | 1.3 |
| 60 | 1.7 | 1.5 | 1.3 |
| 70 | 1.8 | 1.6 | 1.4 |
| 80 | 1.9 | 1.7 | 1.5 |
| 90 | 2.0 | 1.8 | 1.7 |
| 100 | 2.0 | 1.8 | 1.7 |

As shown in Table 4, in different information push time periods, the data throughput of experiment group A is higher than that of experiment Group B and experiment Group C. The data throughput of Group A, Group B, and Group C all reach about 90s. The largest, the maximum throughput of Group A is 2.0 Mbps, and the Experimental Groups B and C Are 1.8 Mbps and 1.7 Mbps respectively. Therefore, compared with the two groups of traditional management models, the maximum throughput of this model is increased by 0.2 Mbps and 0.3 Mbps respectively.

3.2.2 The Second Group of Experimental Results

On the basis of the first group of experiments, the length of the transmitted information data is changed, and the information data generation rate is set to 60 g per second. Test the transmission rate of the three groups of models, and the comparison results are shown in Table 5.

Table 5. Comparison results of the second group of experiments

| Data size (byte) | Group A rate (M/s) | Group B rate (M/s) | Group C rate (M/s) |
|------------------|--------------------|--------------------|--------------------|
| 266532 | 10.26 | 7.89 | 6.08 |
| 298198 | 9.82 | 6.73 | 6.63 |
| 312977 | 9.53 | 5.98 | 5.19 |
| 482977 | 8.72 | 5.87 | 6.54 |
| 739774 | 7.89 | 5.89 | 6.12 |
| 980277 | 8.03 | 4.87 | 4.17 |
| 1098739 | 7.89 | 4.98 | 4.02 |
| 1378472 | 6.73 | 3.27 | 3.02 |
| 1789397 | 6.34 | 4.01 | 3.01 |
| 2088872 | 5.92 | 3.03 | 3.24 |

As shown in Table 5, when the data length is different, the transmission rate of Group A is higher than that of the other two groups, with an average transmission rate of 8.11 m/s, and that of Group B and Group C is 5.25 m/s and 4.80 m/s respectively. Compared with the two traditional models, the transmission rate of Group A is increased by 2.86 m/s and 3.31 m/s respectively. To sum up, the design model in the information service push process, improve the information throughput and transmission rate, information transmission efficiency is higher than the traditional model.

4 Conclusion

This study designs a hotel marketing information management model based on deep learning, which uses deep learning to classify marketing information, improves data throughput and transmission rate, and can effectively provide information services for hotel managers and customers. But there are still some deficiencies in this study, such as the understanding of some specific functions is not in place. In the future research, we will further expand the functions of the hotel, pay attention to the user experience and customer relationship, and improve the user experience of the management model.

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