International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Design and Application of Intelligent Scheduling System Based on Business and Labor Forecasting

Wang Zhongyi[1], Gong Rui[2], Jiang Wen[3], Yang Yang[4], Gou Yangsiyu[5]

Southwest Petroleum University, School of Computer Science and Software, Chengdu, Sichuan, China

Abstract: ***This paper presents an intelligent scheduling system based on business and labor prediction, aimed at addressing the issue of understaffing during peak periods and resource idleness in trough periods in the catering industry. The algorithm design employs Long Short-Term Memory network (LSTM) for passenger flow prediction and genetic algorithm for optimizing staff scheduling to achieve labor demand assessment, work efficiency maximization, and labor cost simplification. The back-end is developed using Java language with SpringBoot framework, while Vue.js and Element-UI are used for front-end development. Data storage is implemented using MySQL database with Redis as cache. The system primarily targets the catering industry.***

Keywords: Springboot, Vue, Scheduling, LSTM, Genetic Algorithm, Catering

1. Introduction

The catering industry holds a significant position within the service sector and serves as a crucial component of many global economies. With economic development, the catering service industry faces increasingly demanding business operations, particularly relying on the tourism sector to drive regional economic growth. Simultaneously, due to fluctuating tourist numbers and fixed positions for catering servers, there is a shortage of service personnel during peak periods of high human traffic flow in the catering industry, while idle staff are present during low-demand periods. In response to these challenges, effective employee scheduling emerges as one of the viable solutions. Given that restaurants often experience fluctuations in customer traffic levels, proper staff scheduling becomes essential for ensuring service quality improvement, enhancing customer satisfaction levels, and managing labor costs effectively. By implementing an efficient scheduling system, restaurants can optimize employees' working hours efficiently by reducing idleness or excessive work intensity among personnel. This ensures sufficient staffing availability during peak hours to meet customer demands while minimizing unnecessary labor expenses during low-demand periods, and thus improving overall operational efficiency significantly. Moreover, an excellent rostering system can also assist employees in better planning their personal time commitments while enhancing job satisfaction levels and reducing employee turnover rates, supporting table operations for the catering industry.

Currently, the staff scheduling system in the catering industry market primarily relies on traditional methods, which involve excessive manual intervention and fail to accommodate various constraints or meet employee needs. This often leads to unnecessary financial waste and confusion regarding staff time management. Furthermore, as the economy continues to develop, there is a growing number of enterprises and commercial establishments. In order for these entities to thrive, competition incentives, cost control measures, and effective personnel management become crucial factors. Particularly within the service industries, it is essential to promptly respond to market changes while accurately meeting customer demands in order to maintain a competitive edge amidst intensifying competition. Therefore, optimizing labor resources through scientific means will increasingly play a vital role in controlling labor costs while simultaneously improving employee experience and customer satisfaction.

The intelligent scheduling system proposed in this paper is based on business and labor prediction, addressing the aforementioned issues. The system utilizes the deep learning LSTM（Long Short-Term Memory）[1] method to accurately forecast passenger flow, enabling determination of the appropriate number of business personnel accordingly. Subsequently, a genetic algorithm [2] optimizes the alignment between labor and business requirements, ensuring that employees are assigned to suitable positions at optimal times. This approach effectively resolves challenges faced by traditional rostering systems, promotes the improvement of labor demand assessment, maximizes employee productivity, and reduces labor costs.

2. Overall framework route of the system

2.1 System development

As shown in Figure 1, the system adopts the development method of front and back- end separation [3]. The backend is developed in java using SpringBoot, SpringMVC and Mybatis-plus is used as the backend development framework. The frontend uses Vue.js with Element-UI as the interface framework. MySQL is used as the base database and Redis as the cache database.

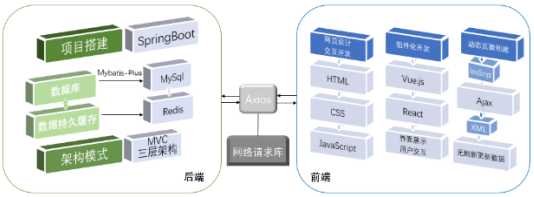

Figure 1: Project development architecture diagram

2.2 Algorithm Design

The system uses LSTM neural network as the passenger flow prediction algorithm. The unique structure of LSTM neural network enables it to effectively capture long-term dependencies and perform well in dealing with time series problems. The genetic algorithm is used as the rostering information optimization algorithm to find the optimal solution of staff rostering. The genetic algorithm has good robustness and thus effectively adapts to different environments of catering work characteristics.

3. System Design

The intelligent scheduling system based on business and labor prediction is primarily composed of the following functional modules: employee information management, shift information management, business and passenger flow prediction, intelligent scheduling, as well as leave and overtime management. The interfaces primarily consist of login registration, main interface, scheduling information management interface, intelligent scheduling interface, and passenger flow prediction interface.

4. Target customers and demands

(1) Chain catering stores
Businesses that need to manage personnel and sales in multiple stores and expect reasonable personnel transfer among multiple stores.

(2) Catering shops with fluctuating customer numbers
Businesses with fluctuating customer numbers that hope to effectively predict customer volume during the corresponding period and automatically generate well-structured staff scheduling information.

5. Main System Function Modules

5.1 Login module

Each user has their own account and password. Firstly, the user enters the correct account and password in corresponding input box, click the "login" button for login verification. Then the system compares the entered credentials with the data stored in the database. If the login account is identified as an administrator account, the user is directed to the administrator interface; otherwise, they are directed to the employee interface. Further details are illustrated in Figure 2.

Figure 2: Login interface

5.2 Employee information management module

The user logs in using the administrator account on the login interface and accesses the administrator system after successful verification. Clicking the "Employee Information" button under the employee management bar in the sidebar, the user enters the employee information interface, where they can view the employee information of all stores. Details are shown in Figure 3.

Figure 3: Store staff information general interface

5.3 business and passenger flow prediction

After successful verification, the user will enter the administrator system. The user can click the customer flow prediction information button in the sidebar to enter the customer flow prediction interface. After selecting the store component, the corresponding store will be selected, and the store traffic in the next week will be automatically predicted and visually displayed at the bottom of the interface. The details are shown in Figure 4.

Figure 4: Business and labor forecasting

5.4 intelligent scheduling

The user uses the administrator account to log in on the login interface and enters the administrator system after successful verification. The user clicks the intelligent scheduling button under the scheduling management bar in the sidebar to jump to the intelligent scheduling interface. After the user selects the corresponding store from the drop-down menu, the system will automatically arrange the scheduling according to the forecast information and visually display it in the interface. The details are shown in Figure 5.

Figure 5: Store automatic scheduling interface

6. Conclusion

The intelligent scheduling system based on business and labor prediction, is primarily utilized in the catering industry for visual data analysis, prediction, and intelligent employee management. This web-based system is developed using front-end and back-end web technologies along with deep learning algorithms. It offers a user-friendly interface, rich functionality, and simple operation. The system overcomes the limitations of traditional manual experience personnel management and electronic process system management by providing flexibility and autonomy. It also tackles the challenges posed by diverse employee needs and changing working environments while effectively managing costs associated with customer fluctuations in stores. Merchants can easily manage store information, staff details, and scheduling information through this system. Employees can access real-time scheduling updates as well as manage their personal work information efficiently. By implementing this system, businesses can promptly address staff turnover issues in the catering market while accurately determining customer numbers to provide high-quality services, which effectively resolve existing problems in traditional personnel management approaches.

Fund Project: Southwest Petroleum University 2023 College Student Innovation and Entrepreneurship Training Program Project "Intelligent Scheduling System Based on Business and Labor Forecasting" (202310615101).

References

[1] Hochreiter S , Schmidhuber J .Long Short-Term Memory[J].Neural Computation, 1997, 9(8):1735-1780.DOI:10.1162/neco.1997.9.8.1735.
[2] Goldberg D E .Genetic Algorithms in Search, Optimization, and Machine Learning[J].Addison-Wesley Pub. Co. 1989.DOI:10.1111/j.1365-2486.2009.02080.x.
[3] Chidamber S R , Kemerer C F .A metrics suite for object oriented design[J].Software Engineering IEEE Transactions on, 1994, 20(6):476 - 493.DOI:doi:10.1109/32.295895.

Author Profile

Wang Zhongyi have been studying in School of Computer Science and Software of Southwest Petroleum University, Research direction: system development.