

# Planning and Design of Intelligent Scheduling System for Subway Staff

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**Abstract.** With the rapid development of urban rail transit, the number of workers on the front line of urban rail transit is increasing. With the increase in rail transit network density in most cities, the total number of staff in a single station and the number of staff in the same shift is increasing, which adds difficulty to the overall scheduling of subway staff. At present, most urban subway station staff are arranged manually, in order to reduce manual participation in the process of scheduling, save labor costs, and enhance the rationality of working time arrangement. According to the actual demand, the intelligent scheduling system of subway staff is planned and designed.

**Keywords.** Urban rail transit; Subway stations; Intelligent scheduling system.

## 1. Introduction

With the rapid development of urban rail transit, by the end of 2022, Chinese mainland of 55 cities on the mainland have opened and operated more than 10,000 kilometers of urban rail transit lines, with the operating mileage reaching 10,291.95 kilometers [1]. The number of urban rail transit stations has reached 6,861, and the total number of station operation and management personnel is more than 200,000 [2,3]. In the daily work of the station, the staff scheduling is a common and complicated problem, in fact, the essence of the staff scheduling is a combination optimization problem, when the scale of the problem is large, it will become very complicated [4,5].

Through the field visit and investigation, it is found that most stations currently complete the next month's work plan of all personnel through manual scheduling, and the scheduling work of most stations is carried out by the stationmaster, who mainly uses Excel tables or statistical reports to make scheduling plans [6,7]. Manual scheduling has some disadvantages, such as being time-consuming and laborious, easy to make mistakes, and too random, so it is difficult to ensure the rationality of the scheduling plan [8].

## 2. Intelligent Scheduling System Design Requirements

In order to reduce the degree of manual participation in the process of scheduling work, enhance the rationality of the working time arrangement of staff in various positions, improve work efficiency, reduce the scheduling burden of each work scene group, and

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solve the difficulties of scheduling time and error, intelligent scheduling system needs to be designed from the top level [9,10]. The main requirements are as follows:

(1). The system needs to establish a big data center based on the position details of railway companies and station personnel, use long-term precipitation data, summarize the rules of personnel transfer and promotion, and use data to analyze the dynamic situation of personnel at each station of the line network, to achieve intelligent management of personnel information [11].

(2). The system needs to realize online and real-time on-the-job dynamic monitoring of personnel and support the interconnection with mobile devices.

(3). The system should realize the automatic generation function of the station staff scheduling plan, be able to identify the rest days independently set by staff, and automatically complete the adjustment work of idle positions in relevant periods based on the analysis of total working hours difference data [12].

### **3. The Overall Function of an Intelligent Scheduling System**

Based on the demand analysis of the intelligent scheduling system, the relevant departments of the railway Company for operation and management personnel are decomposed, and the research and development of the intelligent scheduling and attendance system is carried out according to the comprehensive analysis of the company's personnel attendance system, scheduling principles, and the scheduling needs of different first-line departments such as stations. The overall functions and implementation methods of the intelligent scheduling system are as follows:

(1) Employee information management function. It is mainly manifested in: the management of employees' personal information including the updating of academic information and technical title information; Employee account management; and Staff position information. Through the personnel department, the company will carry out the entry procedures for new employees, input their personal information, and assign post departments. Personal information is entered into the system, and search queries can be conducted within the system by number and name.

(2) Intelligent scheduling function. The main performance is automatic scheduling of the station, automatic scheduling of the dispatching center, automatic scheduling of crew, and automatic scheduling of vehicle plants. After the staff log in to the scheduling system and pass the information verification, they can enter the scheduling link through the submenu. After entering the system, they can view the personal scheduling situation, select the scheduling position, set the transfer date, etc., for automatic scheduling Settings, and finally confirm the submission, they can export and print the scheduling table. These functions are realized in the scheduling management module.

(3) Post-dynamic management function. The main performance is the automatic deployment of support personnel, the traceable query of historical duty personnel information, the query of leave personnel on any date, the query of duty personnel information on the same day, the query of job vacancy details. Based on big data technology, the scheduling system can always analyze and evaluate the overall staff on the job that day, and when an emergency occurs in a station or other work scene and additional manpower is temporarily needed, the system can judge and release support information to the terminal equipment of the corresponding personnel.

(4) Attendance management function. The main performance is the attendance statistics and analysis of the personnel in the passenger transport branch center, the

attendance statistics and analysis of the station personnel, and the attendance statistics and analysis of the individual. The system can conduct comprehensive attendance statistics and analysis by week, month, and year according to the data information of the staff's duty arrangement, leave transfer, leave, and so on.

### 4. Systematic Planning and Design Ideas

#### 4.1. The Overall Structure of the Intelligent Scheduling System

The intelligent scheduling system is a deeply integrated technology based on big data and personnel information comprehensive management platform, which can realize real-time monitoring, dynamic deployment, and automatic generation of scheduling plans for on-duty personnel, achieve a reasonable and efficient dynamic personnel management mechanism, and achieve the goal of saving labor costs for enterprises and improving the overall work efficiency. The overall framework scheme is shown in Figure 1.

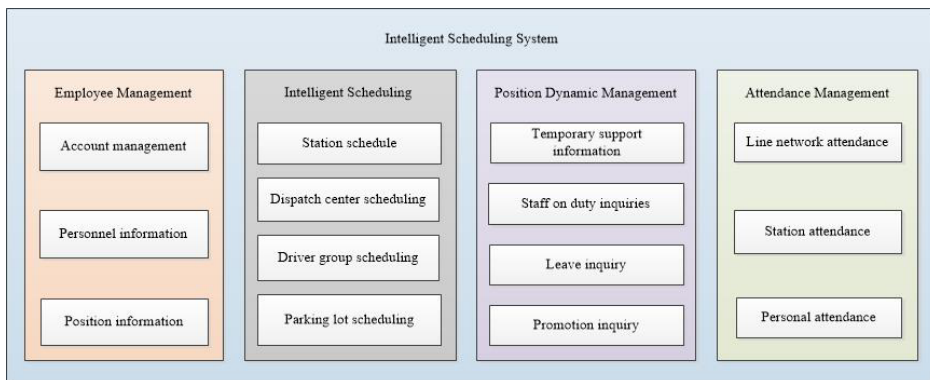


Figure 1. Overall architecture scheme of intelligent scheduling system

#### 4.2. Datasheet Design

The intelligent scheduling system can use MYSQL as the background database, and the specific data structure type of the data table is designed as follows:

- (1). Employee attendance information table, as shown in Table 1.

Table 1. Employee attendance information table

Field name	Field type	Length	Whether a null value is allowed	Explain
attend_id	int	11	no	major key
emp_no	varchar	11	no	employee ID
emp_name	varchar	255	no	staff name
attend_begin_time	timestamp	0	no	time to punch in
attend_end_time	timestamp	0	no	time to clock out

- (2). Leave record information table, as shown in Table 2.

**Table 2.** Leave record information table

Field name	Field type	Fength	Whether a null value is allowed	Explain
vacation_id	int	11	no	major key
emp_no	varchar	11	no	employee ID
emp_name	varchar	128	no	staff name
begin_time	date	0	no	start time
end_time	date	0	no	end time
reason	varchar	128	no	reason for leave
approve_name	varchar	128	no	name of the handler
approve_no	varchar	11	no	agent job number
remark	varchar	128		remarks

(3). Personal salary information table, as shown in Table 3.

**Table 3.** Individual salary information table

Field name	Field type	Fength	Whether a null value is allowed	Explain
id	int	11	no	major key
emp_no	varchar	11	no	employee ID
emp_name	varchar	255	no	staff name
work_salery	decimal	10	no	post wage
allowance	decimal	10	no	comprehensive subsidy
vacation	decimal	10	no	money withheld for leave
reward	decimal	10	no	bonus
absent	decimal	10	no	money withheld from absenteeism
total	decimal	10	no	total wage bill
createtime	date	0	no	issue date

(4). User login information table, as shown in Table 4.

**Table 4.** User information table

Field name	Field type	Fength	Whether a null value is allowed	Explain
userID	varchar	11	no	major key
admin_name	varchar	5	no	login ID
admin_password	varchar	11	no	password
role_name	varchar	255	no	character name
role_description	varchar	255	no	role description

#### 4.3. Part of the module function implementation of the operation flow design

Operation flow is an important part of system design. Whether the operation process is convenient is a key factor in reflecting whether a system is mature and intelligent. The operation process often needs constant adjustment and optimization during the

application of the system.

(1). Employee management module, the administrator enters the main page of the system, searches the employee information, clicks Add employee, fills in the employee information, and submits it when completed, otherwise it can be canceled and the execution is over. The specific execution process is shown in Figure 2.

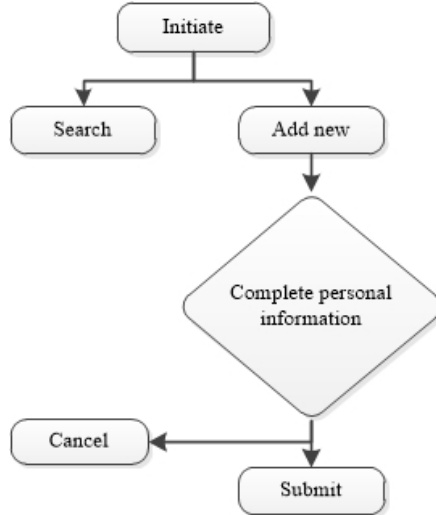


Figure 2. Add an employee information flow chart

(2). Scheduling management module, the administrator logs in to the system, clicks scheduling, enters the time and class system, clicks scheduling, and finally exports the scheduling table. The specific execution process is shown in Figure 3.

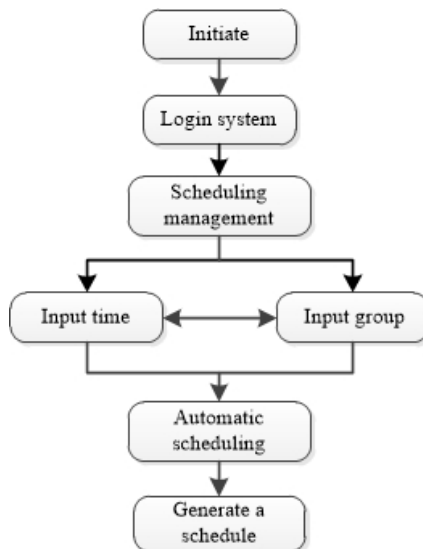


Figure 3. System scheduling flow chart

(3). In the leave management module, the administrator logs in to the system, clicks

on leave management, applies for leave, fills in the basic information, and finally the administrator approves and sells leave. The specific execution process is shown in Figure 4.

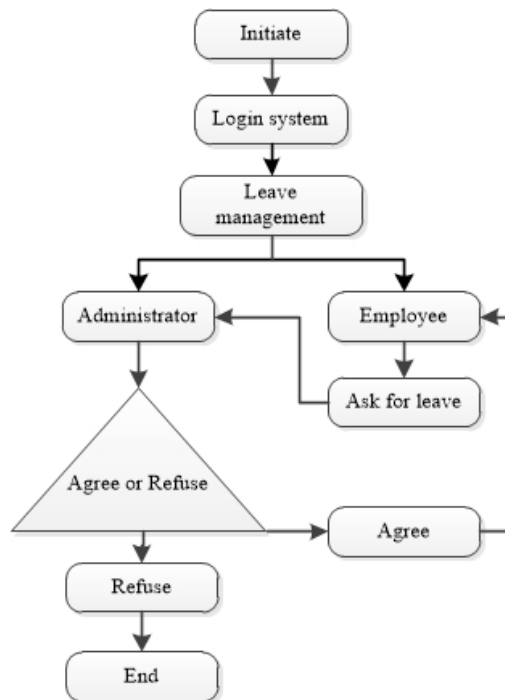


Figure 4. Leave management flow chart

## 5. Conclusion

Under the background of the rapid development of urban rail transit and the increasing number of staff at the front line of urban rail transit, and with the future development focus on improving the operating efficiency of subway stations, the research and application of the intelligent scheduling system for subway staff should be paid attention to. The research and application of the system can effectively improve the personnel management level of subway operating enterprises. The process of shift scheduling operation is simplified, the position setting of enterprises is optimized, the workload of repetitive manual shift scheduling and tabulation is reduced, the labor cost is reduced, and the service quality and operating efficiency of subway operating enterprises are improved.

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