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Research on Standardization of Train Dispatcher Operations

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Abstract: Based on the actual operation of daily train reception and departure at stations, the author conducted research on the standardized operation evaluation of train dispatchers. Through the research of the project, a 1:1 station simulation training system is simulated, using technologies such as eye movement recognition, limb motion recognition, and speech recognition to record and analyze the "eye, finger, and mouth call" operation information of train dispatchers. Combined with the operation analysis of the CTC system, the standardization of train dispatchers' work is achieved.

Keywords: Train Dispatcher; Standardized Homework; Sight; Fingers; Breath

In recent years, with the rapid development of new technologies such as big data, eye movement detection, posture recognition, and system simulation, the author has conducted research on the standardized operation evaluation of station duty personnel based on the actual operation of daily train reception and departure at stations, using the above new technologies to achieve intelligent analysis and evaluation of standardized operation of station dispatchers' "eyes, fingers, and mouth calls". Based on the evaluation results and their weaknesses, set training thresholds and carry out reinforcement training to achieve the goal of correction and improvement.

1. Research background

The operation of train reception and departure at a station is a key link to ensure the smooth flow of the station and road network. The operation of train reception and departure at a station involves many links, a wide range of factors, and a high degree of complexity. Therefore, there are very high requirements for the standardized operation of train dispatchers[2].

At present, in terms of standardized evaluation and intervention correction of train dispatchers' operations, the level of informatization and intelligence is relatively low. The evaluation is mainly completed through on-site monitoring by management personnel and analysis of operation videos. Intervention correction is completed through assessment and on-site tracking, which requires a lot of management time for on-site monitoring. Moreover, the sensitivity of operation video analysis is low and the effect is not ideal. In recent years, with the rapid development of new technologies such as big data, artificial intelligence, machine learning, eye movement detection, limb posture recognition, and system simulation, new ideas, methods, and technical means have been provided for the standardized intelligent evaluation of train dispatchers' operations.

The author conducts research on the standardized operation evaluation of train dispatchers based on the actual daily train reception and departure operations at stations. Through the research of the project, a 1:1 station simulation training system is simulated, using technologies such as eye movement recognition, limb motion recognition, and speech recognition to record and analyze the "eye, finger, and mouth call" operation information of train dispatchers. Combined with the operation analysis of the CTC system, the standardization of train dispatchers' work is achieved. Through the implementation of the project: (1) For new train dispatchers, automatically identify non-standard work situations, timely correct actions and language, and form standardized habits. (2) To rectify and improve the weak links in the standardized operation of current train dispatchers. (3) In response to the difficulty of remote supervision and guidance for standardized operations, we will comprehensively grasp the operation situation of each station and achieve remote guidance for emergency response at the station.

2. Research contents

This project is based on the actual operation of train dispatchers and conducts research through the evaluation of standardized operation of train dispatchers, in order to improve the standardized operation and emergency response level of train dispatchers. The project focuses on conducting the following research:

Standardized job analysis, evaluation, and intervention correction for train dispatchers in a simulation environment. By building a 1:1

station simulation training platform, deploy eye movement, action, and speech recognition devices, including CTC train service terminals, simulated FAS machines, computer interlocking systems, electronic train operation vouchers,etc., seen as figure 1:

Figure 1 Example of terminal interfaces for the simulation system of receiving and dispatching trains

To collect eye movement, movement, and voice data of train dispatchers, and use machine learning, deep learning, visual modeling, etc. to achieve data analysis and recording. Combined with the operation record data of the CTC system, perform matching analysis, and achieve intelligent analysis and evaluation of standardized operations of train dispatchers' "eyes, fingers, and mouth calls". Based on the evaluation results and their weaknesses, set training thresholds and carry out reinforcement training to achieve the goal of correction and improvement.

3. Design scheme

The existing supervision and management of standardized railway operations are carried out by refining rules and regulations, standardizing operational steps, implementing refined monitoring and control, and gradually introducing information technology to carry out more detailed auxiliary management. However, the level of informatization is relatively low, and the investment in new technologies and equipment is insufficient. The management of on-site operation standardization remains focused on human to human management. This project is based on the problem of low informatization and low standardization in existing railway standardization operations[4]. Aim to build a standardized automatic collection system for homework. Based on the simulation environment, deploy eye movement recognition, action recognition, and speech recognition instruments to collect standardized homework data. And combined with the CTC simulation system of the simulation platform to analyze data, complete automatic analysis of standardized operations such as "eye, finger, and mouth calling", automatically evaluate the weak points of train dispatchers' standardized operation abilities, conduct enhanced training, and achieve intervention correction. Based on practical application systems, a 1:1 simulation system is constructed to establish a standardized basic environment for automatic assessment and intervention correction of operations. It can also be used for train dispatchers' simulation training, autonomous training, automatic assessment, and martial arts exercises, The whole model and system are as follow:

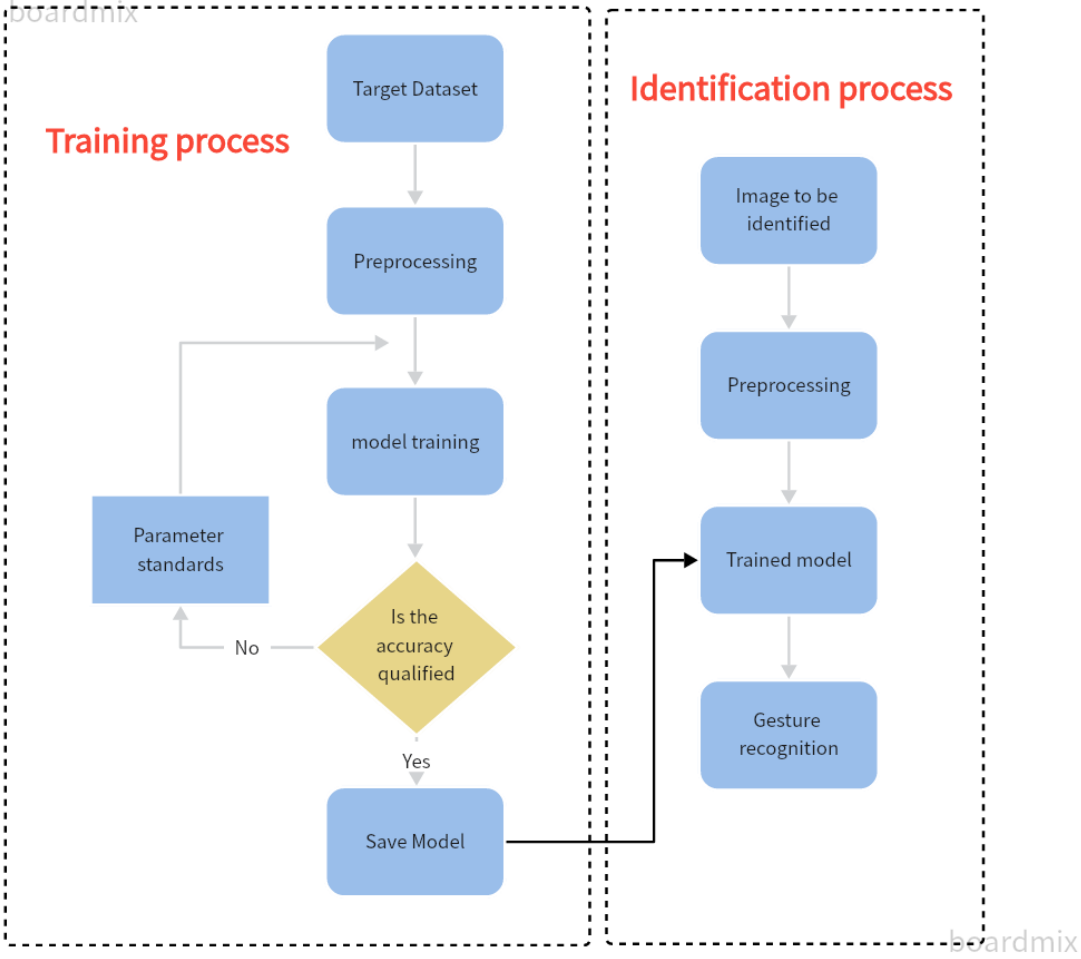


Figure 2 Action (posture) recognition process

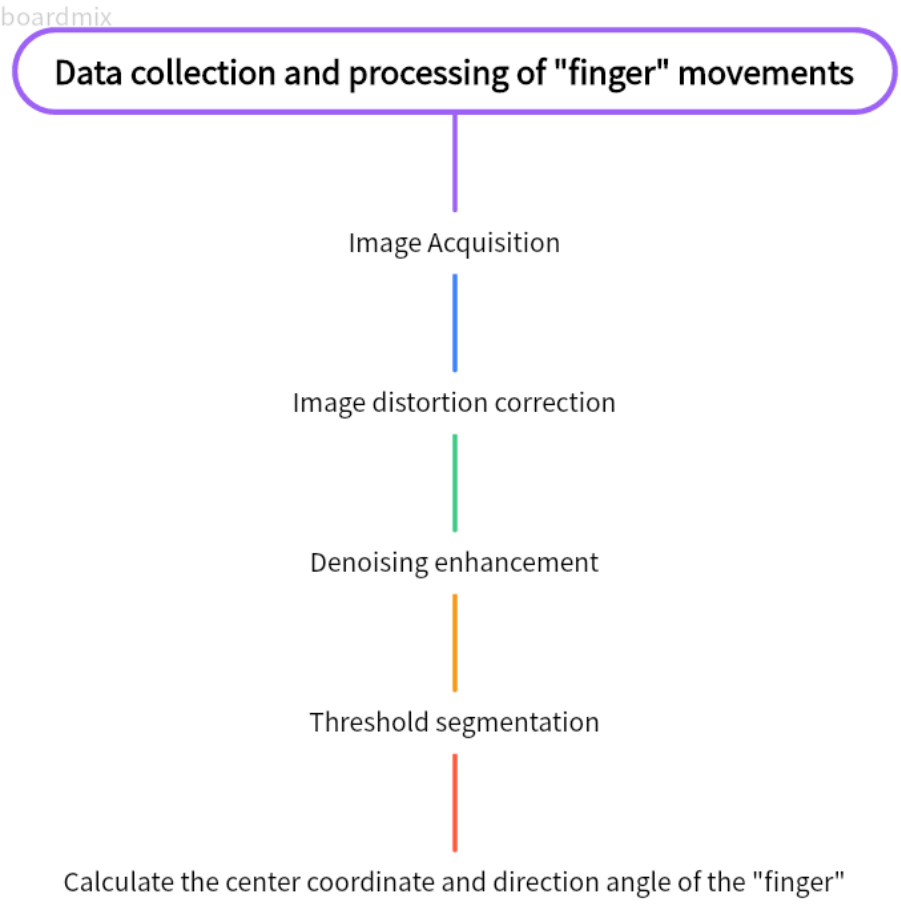


Figure 3 Data Collection and Processing of “finger’ Movements

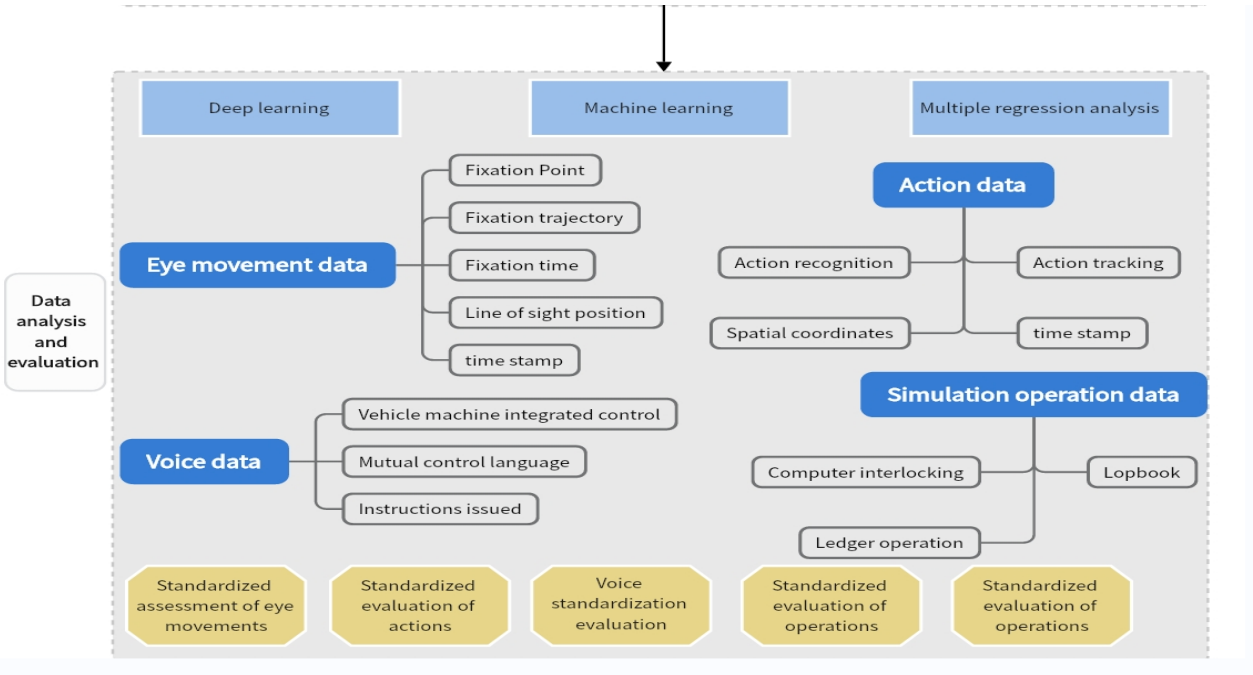


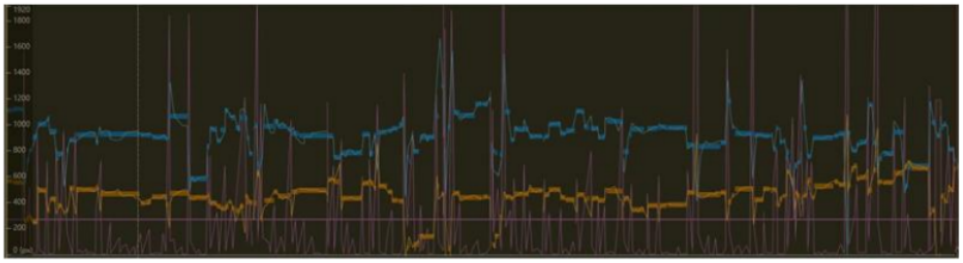
Figure 4 Data Analysis and Evaluation

boardmix

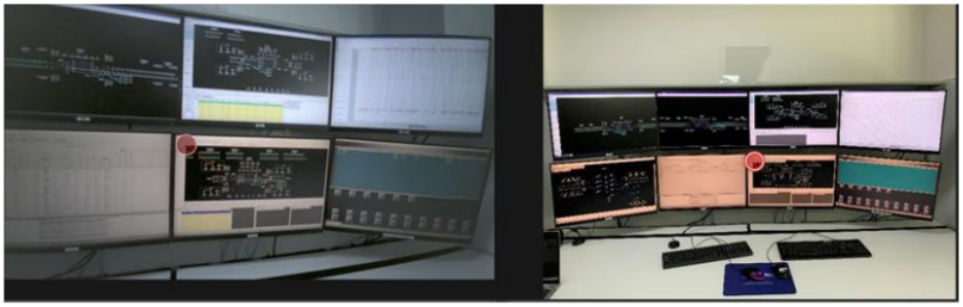
Eye Movement Data and Processing

Gazing trajectory map

Focus on Hotspot Map



Relative position map of gaze behavior



Real time fixation point

boardmix

Figure 5 Eye Movement Data and Processing

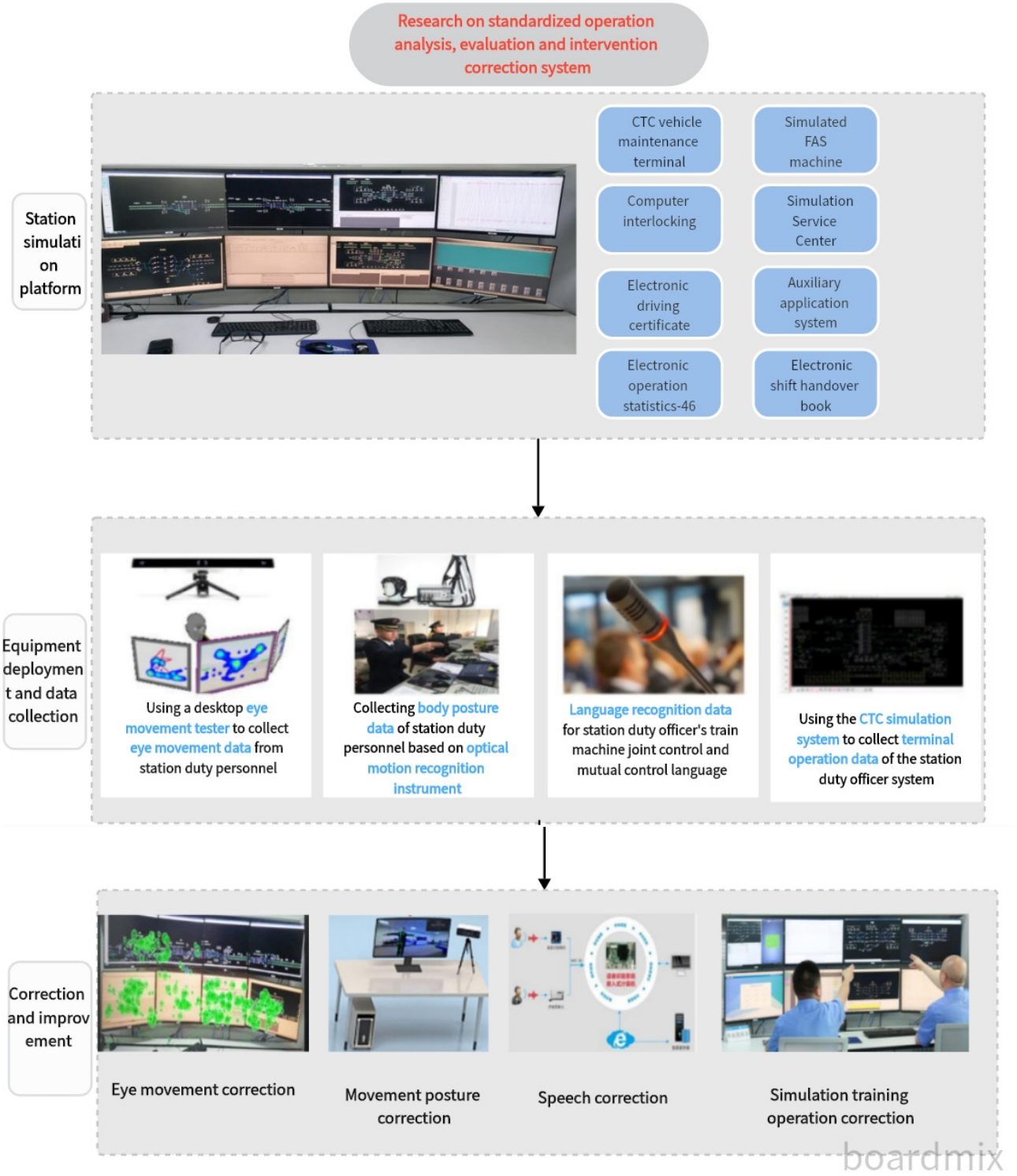


Figure 6 Simulation Platform, Evaluation and Intervention Correction System[1]

4. Project innovation

(1) To Establish a standardized “eye view” homework technology method based on eye movement recognition. Based on machine learning and deep learning technology, achieve standardized automatic collection and analysis of train dispatchers’ “eye to eye” operations.

(2) To Establish a standardized evaluation technology for “fingers” based on limb posture recognition technology. By utilizing deep

learning and visual PnP models, automatic measurement of train dispatchers' movements and postures can be achieved, and standardized automatic collection and analysis of train dispatchers' "fingers" can be achieved.

(3) To Establish a standardized evaluation method for "voice calling" based on speech recognition technology. Using speech recognition technology, build a railway professional vocabulary library, such as train number, train number, track, direction, train operation/shunting instructions, scheduling commands, train machine control language, protective card control language, and other professional terminology vocabulary, to achieve automatic collection and analysis of train dispatchers' operating voice, shunting, construction, and other work[3].

5. Project characteristics

The existing supervision and management of standardized railway operations are carried out by refining rules and regulations, standardizing operational steps, implementing refined monitoring and control, and gradually introducing information technology to carry out more detailed auxiliary management. However, the level of informatization is relatively low, and the investment in new technologies and equipment is insufficient. The management of on-site operation standardization remains focused on human to human management. This project is based on the problem of low informatization and low standardization in existing railway standardization operations. Aim to build a standardized automatic collection system for homework. Based on the simulation environment, deploy eye movement recognition, action recognition, and speech recognition instruments to collect standardized homework data. And combined with the CTC simulation system of the simulation platform to analyze data, complete automatic analysis of standardized operations such as "eye, finger, and mouth calling", automatically evaluate the weak points of train dispatchers' standardized operation abilities, conduct enhanced training, and achieve intervention correction. Based on practical application systems, a 1:1 simulation system is constructed to establish a standardized basic environment for automatic assessment and intervention correction of operations. It can also be used for train dispatchers' simulation training, autonomous training, automatic assessment, and martial arts exercises.

6. Application prospect

Under normal circumstances, train dispatchers strictly follow the standards for receiving and dispatching trains, and the repetitive labor load is relatively small. When the train equipment malfunctions, operating conditions change, and abnormal situations such as line construction and maintenance occur during the operation of receiving and dispatching trains, it is often difficult to take into account both sides, and the workload is relatively large. In the actual transportation organization work on the railway site, there are relatively few operations for receiving and dispatching trains under abnormal circumstances. However, once they occur, if not handled properly, accidents that may endanger the safety of train operation will occur. Therefore, it is particularly important to carry out standardized operation evaluation and correction for train dispatchers[5]. When train dispatchers are unable to comprehensively consider the situation, providing corresponding prompts can not only strengthen the emergency response ability of train dispatchers, turn abnormal situations into normal situations, but also effectively reduce the psychological pressure and workload of station duty personnel under abnormal circumstances.

The operation of train reception and departure at a station is a key link to ensure the smooth flow of the station and road network. There are many links, wide design factors, and high complexity in the operation of train reception and departure at a station, so there are very high requirements for the standardized operation of train dispatchers. Currently, in terms of standardized evaluation and intervention correction for train dispatchers, the level of informatization and intelligence is relatively low, and there is no complete standardized operation evaluation and intervention system for station duty personnel. The evaluation mainly relies on on-site monitoring by management personnel and analysis of operation videos. Intervention correction is completed through assessment and on-site tracking. The sensitivity of operation video analysis is low, and feedback is slow, resulting in unsatisfactory results. Establish a station simulation training system that utilizes technologies such as eye movement recognition, limb recognition, and speech recognition, combined with CTC system operation analysis, to automatically recognize non-standard work situations, correct actions and language in a timely manner, and help train dispatchers form standardized habits.

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