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Intelligent Monitoring and Control System for underground mine rail transportation based on communication-based train control (CBTC) system and AI computing

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***Abstract*—This paper focuses on the study of the CBTC system of Urban Rail Transit and the possibility of its application in the intelligent monitoring system of Mine Rail Transit. The innovation of this paper is to apply the ATO system, ATP system and ATS system of CBTC system to the rail transportation of intelligent underground mine. And this paper is of great significance to the development of the monitoring and control system of underground mine rail transportation.**

Keywords-Intelligent underground mine; Rail transportation; Underground traffic; Monitoring and control system

I. INTRODUCTION

In the 21th century, more and more mining engineers and scholars have devoted themselves to the intelligentization of the underground mine, especially the research and the development of the intelligent transportation.

However, with the continuous development of underground mining industry, the trackless transport has gradually replaced the status of the rail transport. But there is no doubt that the monitoring and control effect of trackless transportation in underground mines is not as convenient as that of rail transportation, especially in China, which is behind the world in the development of underground mining, although China can not reach the absolute intelligentization of trackless transportation, China has made a great breakthrough in the intelligentization of underground mine rail transportation.

The focus of this viewpoint article is the intelligent rail transportation of the underground mines.

And this paper is based on the monitoring system of Urban Rail Transit and the structure of the CBTC system of urban rail transit, applying CBTC system in the rail transportation of intelligent underground mine.

II. LITERATURE REVIEW

This part briefly introduces the content of CBTC system through the literature review:

CBTC system is an advanced monitoring and control system for the above-ground urban rail vehicles, which is applied to urban rail transit lines in various countries.

Here are the figures to introduce the main contents of the CBTC system.

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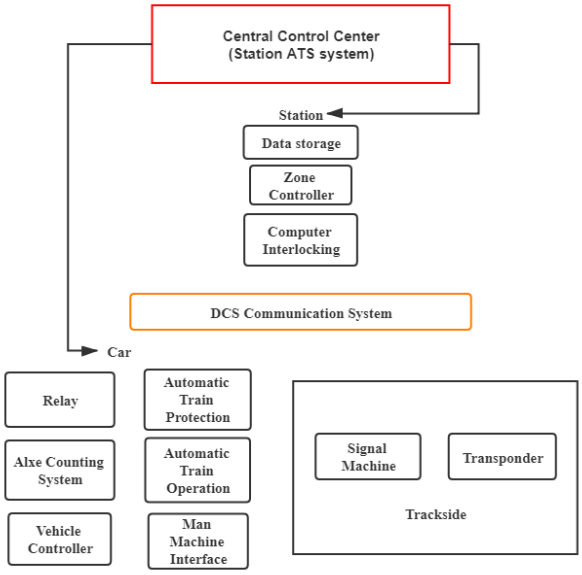

Figure 1. The structure of CBTC system.

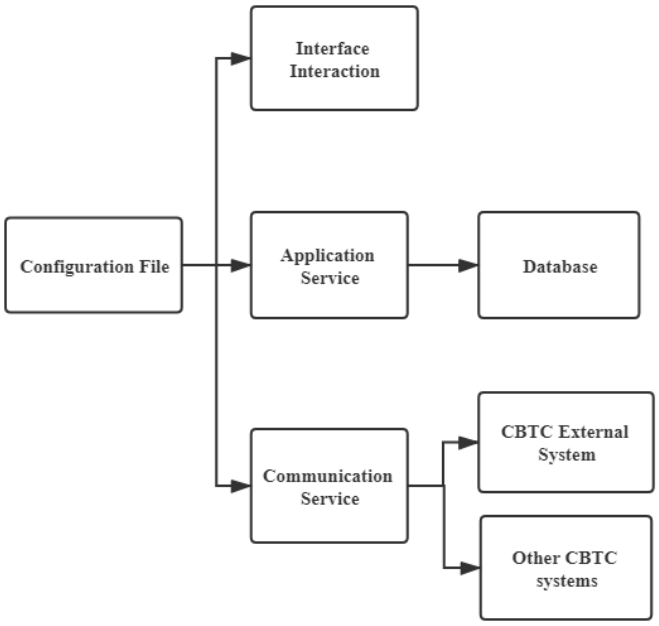

Figure 2. The structure of ATS system.

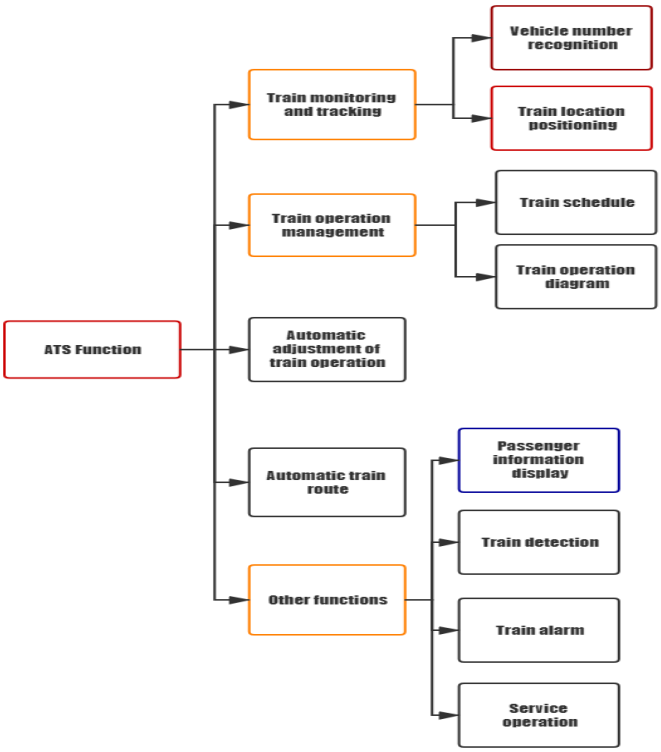

Figure 3. The functions of ATS system.

CBTC system has a great-effective application not only on the above-ground urban rail transportation, but also on the operation and monitoring of underground rail transportation such as subway.

Thus, it is believed that CBTC system is bound to be greatly used in intelligent underground mine transportation after the appropriate improvements.

III. Purpose

To put forward the innovative viewpoint that applies ATP system, ATO system and ATS system of the CBTC system to the underground intelligent mine rail transportation.

IV. Methods

In this part, the improved CBTC system is combined with AI computing to solve the following problems in underground rail transportation.

A. The rear-end collision problem

In the majority underground mines of the world, the main transport equipment on the track is electric locomotive, which is replaced by transport units in the following text.

To avoid rear-end collision accidents, ATP system plays an important role controlling the speed and distance between the transport units.

B. The transport efficiency problem

ATP system directly control the speed of the transport units and ATO system provides the information of the transport units to ATP system. With the assistance of AI computing, ATP system and ATO system together control the transport units to reach the maximize efficiency.

C. The real-time monitoring problem

As the core of CBTC system, ATS system is Automatic Train Supervision System which is divided into linear, centralized control, centralized monitoring and decentralized control to realize the real-time monitoring. If the real-time monitoring of transport units can be realized, it will be beneficial to mining production industry, such as mine accident monitoring and personnel search and rescue.

The followed problem required to be solved:

1) The real-time monitoring function of the transport units

The ATS system continuously tracks the location of each transportation unit. The position of each transportation unit is also continuously calibrated by the identification sensors on the track, and the real-time tracking information of each transportation unit is fed back to the screen of the control center.

2) The start-up time control function of the transport units

When the Stope in the intelligent underground mine does not need any transportation operation, each transport unit needs to stand by in the warehouse. Once a stope needs transportation operation, the ATS system calculates the amount of transportation units needed by AI computing and controls the transportation units to the stope to participate in the transportation operation, parameters such as ATP system and ATO system, to help control the speed of the transport units.

3) The route adjustment function of the transport units

In intelligent underground mines, there are usually more than one concentrators set, so transport units often have many unloading points to unload, through the ATS system and AI computing function, to analyze the congestion of each line, automatic selection of the best unloading point route for each transportation unit involved in the transportation operation.

V. CONCLUSION

This paper is just a viewpoint article, by improving the three systems of ATP system, ATO system and ATS system in CBTC system, this paper applies them to the intelligent monitoring and control of rail transportation in underground mine.

We also carried on the program design as well as the follow-up process simulation, according to the simulation results, although there are still many problems, but we still have more satisfactory results. The simulation results show that if the CBTC system can be further improved and perfected, the CBTC system will eventually be able to be used in intelligent underground mine rail transportation.

The conclusions of this study serve only as a guide to the Tossing out a brick to get a jade gem, and hope more scholars will be interested in this direction of the research.

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