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Railway automatic safety protection system based on GPS

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Abstract：The automatic protection system of railway safety is designed for the railway construction workers to protect alarm, and the safety protection device by using GPS satellite positioning system to acquire location information of the operating point, through the CTC/TDCS system and computer monitoring system for the running of the train position and the arithmetic distance. Achieving timely and continuously forecasts about the distance of the train which is apart from the operating point to prompt the voice alarm of the approaching train. Using digital technology to realize the function of the traditional analog interphone, eliminates the quality problems of the call. With the GSM-R, mobile wireless transmission channel and terminal technology, it overcomes the restrictions of the analog interphone which influenced by communication distance and more problems of blind areas. Finally to achieve practical, convenient, applicable and adaptable design goals.

1 Introduction

The increase of the train speed has greatly increased the capacity and service quality of the transport, and greatly promoted the national production. However, the speed upgrade brings some security risks, and the train crash people happened frequently which seriously threat the personal safety of personnel, the personnel crossing through the railway and the others on the railway running through.

Especially in railway construction workers on the job, the main works, electricity, train inspection, shunting, power supply, construction and other units of the workers. The main means of communication is by wire or wireless walkie talkie to inform each other, and this dozens years old notification method has been difficult to adapt to the speed and density after speed increase. The first is due to the long time interval operation notice made workers form the paralysis of thought in mind, that they can also do it in a few minutes; The second is the personnel who is responsible for informing that often forget the risk of accidents and notify the operating personnel factors, and even sometimes occurred the problems telephone channel and other reasons not to operating personnel; The third is the phone notice because of language expression, the field operation personnel can't hear the uplink, downlink and several road trips clearly; The forth is due to bad weather, such as line curve look bad, and lead to adult injury accident[1].

How to improve the safety index and reduce the incidence of accidents is the all cadres and workers are most concerned after the increased speed, it is also an important issue which needs to be solved. This paper discusses the issues and put forward the technical scheme of railway safety automatic protection system.

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2 System structure

2.1 System features

This system is to provide protection alarm to the railway operation personnel ,requiring system has the high reliability and stability. This system has the following characteristics: independent of geographical location which can realize the full range alarm; independent of climate, which can be used normally in all weather conditions delay in short time, the alarm delay can be controlled to 3 seconds; support people voice alarm information can be used in or out the station[2].

2.2 System structure

The system consists of the ground signal acquisition terminal, I alarm terminal, II alarm terminal, alarm center server and monitoring terminal. The system architecture is shown in Figure 1.

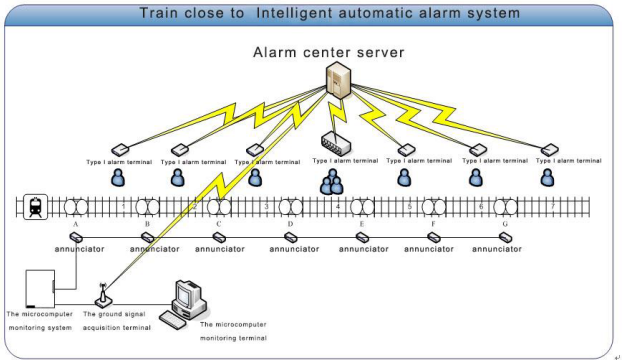

Figure 1. System architecture diagram

2.3 Introduction of the function of each part

The ground signal acquisition terminal is responsible for collecting the train signal and operation information to the alarm center server; I alarm terminal is applied to the construction personnel to wear which can automatically the coming track and be self checking to give abnormal alarm automatically. It can also get their own position by GPS, and sent its location to the alarm center server. The server can in voiced and light alarm after receiving the alarm, with voice calls and video transmission function; The function of II and I alarm terminal is similar, but the double GPS and double GPRS channel receiver is more suitable for the construction of the team alarm; alarm center server installed on the mobile room, according to the size, it can be worked in cluster which can track the I type and II type alarm position information of the terminal, converted to latitude, longitude and kilometer, communicate with the ground signal acquisition terminal, which can obtain the information of the train operation to analyze the alarm terminal which into the warning area and notify the alarm; computer monitoring terminal is responsible for monitoring the construction personnel on the railway station, monitoring the alarm notification information check, alarm history, and is responsible for notifying the attendant to a dangerous situation for manual alarm, which can be done by the computer control center.

3 System working principle

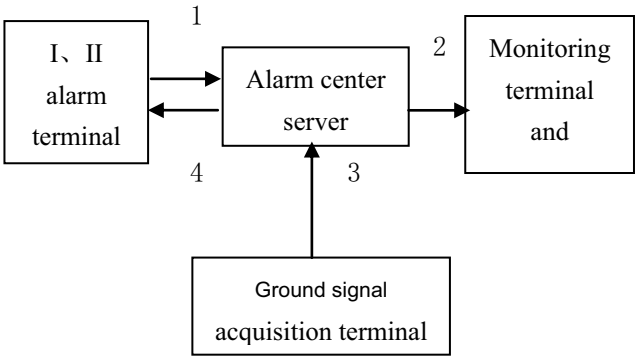

Figure 2. Schematic diagram

I, II type of alarm terminal real-time acquisition of their position, and sending alarm center server. The alarm center server notifies the distribution of operations personnel to monitoring terminal, when the ground signal acquisition terminal receives a train passing through the insulating section information, notifying the alarm center server the train location, speed, up and down. The alarm center server through calculation, obtained 1, 2, 3 level alarm device, and to alarm. The alarm center server received alarm equipment identification information, and sends the result to the PC monitoring terminal display.

3.1 Working principle of ground signal acquisition terminal

The terminal can communicate through RS232 interface and control center, and upload them to the central server. Meanwhile, the server receives the alarm notification.

As shown in Figure 3, the wireless module receives the alarm center server send alarm notification data through the asynchronous serial port UART is sent to the CPU terminal. The data checking and decrypting by sending a RS485/RS232 communication interface to the computer monitoring terminal. Signal information to the CPU for data encryption by sending a RS485/RS232 communication interface, while the formation of cyclic redundancy check code packaged with the CRC16 data, the formation of a data frame, and then by the asynchronous serial port UART is sent to the wireless module is transmitted to the alarm center server, complete the network data transmission.

Each terminal has a fixed address, which is to identify the word recognition of the terminal. The terminal in the data processing of the first is to detect whether the packet is a local address. If it is the local address for data processing, or drop the packet in order to ensure the accuracy of the data to the terminal; the data package will be packaged together to address the data.

3.2 Working principle of the alarm terminal

I alarm terminal for construction personnel to work independently of the train approaching alarm. The terminal start the GPS module to self-test when the power is supported. At the same time to prepare the ready alarm lights. After satellite synchronous open GPRS connection to the server and report the location and status. The server received confirmation is not ready for the lights, work lights (green) light, this time into the construction state. When the alarm terminal server received the alarm, it will according to the alarm level to open the corresponding level horn sound. At the same time the vibration motor vibration alarm, flashing lights. When receiving the alarm termination notice, stop all alarm. After receiving alarm notification, it's no more than 1 minute which stopped alarm automatically when overtime. Enhanced terminal with two-way voice and video transmission function.

II alarm terminal is used for train approaching alarm by construction personnel working. Compared to I type terminal, it reduces vibration alarm function which increase the speaker power and driving ability. In order to ensure the reliability of the system, the system adopts double parallel working mode.

3.3 The call function of railway safety automatic protection system

The call function of railway safety automatic protection system by using digital technology to achieve the functions of the traditional analog interphone, one click you can call. To solve the limited blind spot of traditional analog interphone communication distance, but also can solve the problem that the traditional telephone to dial 11 digits to wait several seconds or longer to call, if the other is a calling also do not know when to call, no matter how much you urgent things, you can only wait patiently.

The voice of railway safety automatic protection system call function has the following characteristics:

3.3.1 Emergency

The voice function of railway safety automatic protection system set up time is short (less than 500ms), to achieve a real push to talk. In the face of unexpected events, to group cooperative work which must be timely communication between groups to jointly cope with a sudden event in question. If there is a push to talk, not to the user level which will be unable to command the command into a group action and it will delay the time and result in significant loss. Emergency is the main voice characteristics of railway safety automatic protection system call function.

3.3.2 Group

The voice of railway safety automatic protection system call function not only to achieve a single call, more important can do group group call, group call, broadcast, and call the different professional groups of users, in order to achieve the group cooperative work.

3.3.3 Controllability

The voice of railway safety automatic protection system call function is the use of hierarchy, which is provided with a dispatch command center, which can monitor the user state within the system, it can adjust the user call according to the needs of the work to achieve reasonable

allocation of personnel and effective working state[3].

3.3.4 Special function

As the voice of railway safety automatic protection system call function is used in the hierarchical, network users are not equal, it has a strong, demolition, emergency alarm, and other functions, to ensure the effective work of the command center. The waiting, as long as the user initiates a call, temporarily not connected, it will no longer need to call the control center, according to the operation of the system, at any time to call back call tips, improve the professional network efficiency. The system of voice calls through dynamic reorganization of function, directing work mode (DMO) is an indispensable function of railway safety automatic protection system function.

4 Summary

The safety protection device by using the GPS to obtain the location information for the operating point location and the running position of the train through the CTC/TDCS system and computer monitoring system for operation, find out the distance. Achieving timely continuous prediction of train operating point of the distance from the voice alarm of a train approaching,. Realize the function of traditional analog interphone by using digital technology and eliminating the call quality problems existing in analog radios. Due to the adoption of the GSM-R, the mobile wireless transmission channel and terminal technology to overcome the analog radio communication distance limitations and there are many blind spots, and ultimately to achieve the design goals of practice, convenience, appliance and strong adaptability.

References

1. Jian zhen Liu, Science & Technology Ecnony Market，8(2010)
2. Han wu Sun， SWJTU，(2008)
3. Xiao he Li，BUPT，(2009)