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Multi-information Location Data Fusion System of Railway Signal Based on Cloud Computing

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Abstract: In order to solve the problems of multi-source heterogeneous, mass storage, and information sharing of traditional railway signal multi-information location data, based on the analysis of railway big data environment, the architecture of the cloud physics-based information physical fusion system (CPS) was proposed. The service division and hierarchical combination of the architecture were analyzed. Taking the railway signal multiple information train positioning data as an example, a real-time processing method of railway large data stream based on Storm was proposed. Finally, the cloud storage model designed in this paper was compared with the traditional stand-alone architecture. The results showed that this system had a greater advantage in handling large amounts of data. To sum up, the system has practical application value in the processing of multi-information location data of railway signals.

Keywords: CPS; train positioning data; cloud computing; large data; railway signals

1. Introduction

Tens of thousands of various types of sensors and communications equipment along the railway line generate huge amounts of data every day[1]. These large numbers of small calculators interact with each other and assist in the formation of a large system of collection, communication and control. Obviously, the big data driven railway information physical fusion system is becoming a new situation[2]. With the rapid development of train operation control systems and the emergence of big data, train control systems have become more and more complex. There are more and more parts. The variety is also very rich. Various heterogeneous multi-source systems cause diversity and inconsistency in information. Therefore, a railway information sharing platform based on big data is constructed to solve the problems of inconsistent data, low sharing efficiency, and difficulty in data mining[3]. The technology of big data is fully utilized to improve the efficient operation, safe operation, and humanized operation of the railway[4]. With the increasing complexity of system components and the increase of members, the interaction between the continuous behavior of railway hybrid systems and the discrete behavior of the computer world, modeling, and simulation are crucial to the understanding and safe operation of the system [5-6].

In foreign countries, research on CPS is mainly concentrated in the United States, the European Union, Japan and South Korea and other countries. In 2006, the United States began to list the CPS as an important research project. In 2007 and 2008, the United States again listed CPS as the top eight key information technologies in the network and information field, and also used CPS in large areas such as transportation, defense, medical care, and energy [7]. In China, starting in 2008, it mainly focused on the development of the industrial sector. In 2010, it began to interrelate with the Internet of Things, sensor networks, and embedded systems to form a wider range of multi-level system science [8]. However, from the perspective of these major scientific research results, the analysis of the hybrid system behavior of the CPS of the train operation control system is still in its infancy. It also does not involve the most important big data storage and real-time processing of the CPS system under the big data environment. Formal modeling based on state analysis is also not suitable for modeling large systems. Therefore, there are still many problems to be solved in theory and technology. Taking the railway signal multi information train location data as an example, the CPS architecture based on cloud computing is proposed, which also has some reference value for the research of CPS.

2. Methodology

2.1 CPS system architecture based on Cloud Computing

The CPS architecture is the basis of the whole system analysis and development. The three subsystems of CPS business logic with tightly integrated decision-making, control and perception operate in different time and space, and are connected by a powerful network infrastructure. This is a complete CPS architecture [9]. Based on the advantages of cloud computing, the various subsystems of the CPS system can exist independently as a service and be shared on the platform. Any CPS system that matches the physical world can be divided into three types of basic induction, processing, and control services.

The first service type is induction service. Cloud-based sensing services will allow users to easily access a large number of different types of cross-domain CPS sensing capabilities. A suitable degree of sensing service abstraction will simplify the integration, sharing, and management of CPS sensing [10]. Therefore, three