The research of safe computer simulation test system

Zhang Yan Chen Wei

Department of Information Engineering of Jiangxi Technical College of Manufacturing. JiangXi Nanchang, 330095

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Abstract. In recent years, with the development of China's economy, progress of society and improvement of people's life, cars have been bought by thousands of families, bringing great convenience as well as traffic load. Heavy traffic becomes the issue people have to face when going out. It also constrains the development of economy and society of our country. Purely widening the road cannot solve the problem of traffic jam both practically and efficiently. Use the developed foreign countries for reference. Public transport situation can be improved fundamentally through urban rail transit technology. Superincumbent design is utilized to build an overall model of safe computer system simulation system to make it simulate the external environment and settings of safe computer system.

Introduction

With the development of science and technology, a new generation rail transit technology is gradually digital, automatic and intelligent. Automation control theory is applied to rail transit increasingly. The urban rail transit signal appliance includes train dispatching system and train control system. The dispatching system is to schedule the trains on the railway and the operation of trains. The control system is the core, which is responsible for supervision of the appliances of the train, operation control, information management and failure process.

The safety, reliability and availability of the safe computer system which is the key to rail transit equipment directly affect the safety of people's life and possessions. Thus, the design and development of the safe computer system requires a series of strict tests to guarantee its safety and reliability. However, the safe computer system applied to rail transit is quite special, so at the early stage of design, development and test, it is insecure and impractical to conduct site tests on the real route.

The safe computer system refers to the system able to guide the whole system towards safety when it fails. For example, when something happens to the mobile unit of subway trains, it can make the train stop immediately and process the fault so as to avoid the potential hazard caused by the failure. In real life, the breakdown of equipment is unavoidable. Traditional electron device cannot guide the system to safety when breakdown happens. The safe computer system admits that fault is unavoidable and takes some measures to relieve the effect.

The review of simulation technology and the research status of safe computer simulation system

Simulation technology is an integrative technology involving multiple subjects. On the basis of control theory, system theory, information technology and principle of similitude, by taking specific

device and computer as tools, it uses a model of the system to conduct dynamic experiment on real or imaginary system. Simulation technology is people's imitating and abstracting the real system in a certain aspect. By simulating the real system, it can obtain some essential information and then solve the problems appearing in people's daily life.

In terms of different computers used in the process, simulation can be divided into analog simulation, digital simulation and hybrid simulation. Discrete event system simulation method is to describe mathematical models of such a system not as a set of mathematical expression but as a flow chart showing quantitative relation and logical relation. It has three parts: arrival model, service model and queue model.

In recent years, intending to verify the safety, reliability and availability of safe computer system, research institutes inland and overseas have constructed plentiful semi-physical simulation system. The signal system controls the traction motor's moves through traction motor controller. The traction motor drives the velocity sensor and carrier band. The velocity sensor produces speed signal. Passive and active transponders installed on the carrier band send transponder signal. Vehicle-mounted signal system (vehicle-mounted controller) gathers speed information and transponder signal. A sensor model is constructed by adopting simulation technology to provide the vehicle-mounted controller with emulational sensor signals.

Computer simulation system aims to simulate the behavior used on sensors and devices of rail transit, to establish an operational environment for rail transit safe computer system, to drive the operation of the system and to test its safety, reliability and availability. The function of this system is to simulate the function of rail transit sensors. The logic operation layer of the safe computer system with two shippers and hot standby is composed of two independent units, each of which has the same hardware structure and software program and can implement same prescribed functions independently.

The design and implementation of simulation system

In reference to the modeling of simulation system, firstly, model the entire operational environment of the safe computer as a whole object, thus making the system able to simulate the operational environment so as to conform more to that of the safe computer system. Secondly, modularize the model of the whole simulation system. The basis for the module division is to model different types of sensor according to the sorts of rail transit sensors and devices.

Based on the hierarchical design theory of sensor's model, the whole system's hardware design also adopts superincumbent hierarchical design method, consisting of control layer, signal generation layer and signal conditioning layer. The logic control layer corresponds with that of the hardware. Signal generation layer and processing layer complete the external interface function of the sensor's model.

Control layer implements the function of logic control layer for the software of the sensor's model. The mainframe of the control layer generates corresponding input and output signals by controlling the reaction boards which controls the signal generation layer through PCI (Peripheral Component Interconnect). The signals of sensor generated from the layer are less accurate and mismatching the electrical level. Hence, GPIO that goes through signal generation layer will conduct accuracy control and level match on the signals generated by signal conditioning layer.

The systematic test of CC platform based on simulation system

Judging from the test of a single model, its input and output parameters can fulfill the demand of real sensor input and output parameters. Nevertheless, it is necessary to test it entirely as the simulation system is considered as a whole. Here we treat the simulation system as a whole and access it to CC platform to complete the systematic test of the CC safe computer platform.

CC safe computer platform system is composed of hardware appliance, VxWorks (the operation system), platform software and application program. The external physical interface of the hardware device is connected with the sensor interface of the simulation system directly, constituting a physical single circuit. The application program can make the Ethernet port of the CC safe computer platform to communicate with the external. Therefore, we can compile the test case operating on the platform software as test app. Test app communicates with the simulation system through an external port of the CC safe computer, thus constituting another circuit.

In the systematic test of vehicle-mounted controller, we use the 70 parameters and as many as 500 test cases of vehicle-mounted controller produced by the simulation system to conduct automation test. The implementation of the test cases is automatic with no manual interruption, which saves the testing time and cost. Seen from the CC impulse frequency test, the simulation system can provide the vehicle-mounted controller with boundary test and fault injection. And the fault injection for the safe computer platform needs not to change the structure and interface of the simulation system model, but just to modify the parameters offered to the model interface, so the fault injection is harmless.

Conclusion

The development of urban rail transit can tremendously solve various problems of heavy traffic to facilitate the progress of society and development of economy. Currently, rail transit grows intelligent and automatic. The safe computer system is the control core of the rail transit, whose safety, reliability and availability have a direct impact on the safety of people’s life and possessions. Aiming to construct a simulation system of the safe computer system for lab tests, this article proposes a design based on model and the combination of software and hardware. It includes four aspects.

Adopting a superincumbent method, the design is for the whole model of the simulation system, ensuring that the system is able to simulate the external environment and settings of the operation of the safe computer system.

According to the functions of sensor of the safe computer system, the whole model of the simulation system is decomposed to independent function units. Then, model each unit to simulate the functions of sensor.

Based on the sensor’s physical characteristics and control principles, hardware circuit and software are designed to implement the entire simulation system.

Test each single model. Compare it with the real input and output of sensor to improve the structure. Apply the simulation system to single-board test and systematic test of the safe computer system. The feasibility and reliability of the design are proved as the functions of the safe computer system are verified.

Owing to shortage of time and the limits of developing conditions, there exist some errors in the analog input and output of electric current loop and accelerated sensor model. It needs to be further

verified whether the accuracy of modeling the sensor's working principle accords to the reality. With the development and improvement of simulation technology, the veracity and precision of the simulation system applied to safe computer system can be enhanced gradually so as to promote the continuous development and progress of the safe computer system.

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