

Study on Building Plan of the Intelligent System for Xiong'an Integrated Transport Hub

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***A**bstract: This paper introduces the current status of the monitoring system building for an integrated transport hub. By analyzing the intelligent building needs of the integrated transport hub in terms of intelligent passenger service, intelligent control of electromechanical equipment, intelligent operation and maintenance, and emergency management, etc., the intelligent system building plan for Xiong'an integrated transport hub is proposed. The unified and virtualized cloud platform of the hub can realize the interoperability of various intelligent systems, providing the basic conditions for the application of the Internet of Things, big data, and AI (Artificial Intelligence) in integrated transport hub. The conclusions of this study have been applied in the intelligent system design of Xiong'an integrated transport hub, and the study results could serve as a reference for the intelligent system building of integrated transport hubs.*

Keywords: Xiong'an; integrated transport hub; intelligentization; information system; cloud platform

(This paper is selected from *Chinese Railway*)

Urban integrated transportation hub refers to a coordinated hub system integrating railway, highway, urban rail transit and other transportation modes, which provides distribution and transit services for large-scale residential areas and major tourists destinations outside and inside the city, therefore working as a bridge connecting the city with the outside world. As an important node to realize green, intelligent and platform-type transportation, the hub needs to be designed to enable intelligent travel and passenger transferring, which is also a demonstration window of urban service level for the city. It is therefore significant^[1-8] for the hub to build intelligently from the fields of passenger service, safety guarantee, operation management and environment protection. The paper proposes an intelligent construction scheme that will be applied to the design of Xiong'an comprehensive transportation hub based on the detailed analysis of the specific needs of the hub and giving consideration to characteristics of Xiong'an hub in covering three types of transportation transfer, namely, national railway, municipal transportation and urban rail.

1 Status quo of the Establishment of the Monitoring System in the Integrated Transportation Hub

There are some differences in the construction schemes of the monitoring system of the comprehensive transportation hub in different regions, but they all cover the BAS (Building Automation System), FAS (Fire Alarm System), communication and other related monitoring systems, and those systems are integrated or interconnected via the comprehensive monitoring system.

1.1 BAS (Building Automation System)

BAS is designed to realize the centralized monitoring of the mechanical and electrical equipment in the comprehensive transportation hub.

Specifically, it monitors the environment, cool water and cooling water system, heat source and heat exchange system, heating ventilation and air conditioning system, water supply and drainage system, automated escalator, elevator and automatic pedestrian escalator system and lighting system. By automatically adjusting the working state of different mechanical and electrical equipment systems, the BAS can guarantee the smooth operation of the comprehensive transportation hub, and therefore providing a good and comfortable riding environment for passengers.

BAS mainly adopts special control systems such as Direct Digital Controller (DDC) or Programmable Logic Controller (PLC), and generally adopts a three-layer networking scheme covering management, control and the site to realize both centralized monitoring operation and decentralized acquisition control of the distributed system.

1.2 FAS (Fire Alarm System)

The comprehensive transportation hub is a highly crowded public place. FAS is installed to protect the personal and property safety of passengers and staff in the hub. FAS has the function of fire detection and alarm releasing, and can comprehensively control such systems as fire extinguishing systems, smoke control and exhaust systems, fire doors, elevators, fire emergency broadcast systems, emergency lighting systems, evacuation instructions and other systems in the hub under fire conditions, so as to mitigate fire risk and hazard.

FAS adopts special fire-fighting equipment in line with national requirements, sets the fire alarm controller and fire linkage controller, connects different kinds of fire detectors, alarm buttons and monitoring control modules through control bus, so as to perform its functions like system detection, alarm and linkage control.

1.3 Communication system

(1) The video monitoring system is installed to collect videos from the passenger service, safety inspection area, stairs, vertical elevators, office

areas and other places in the comprehensive transportation hub, and provides real-time images of relevant occasions for the staff. The system has functions of video storage, playback, and display. The system is composed of front-end acquisition, video distributing & forwarding, storage, system management, user terminal and other equipment. Usually, the network camera is adopted. And a network of video monitoring will be established separately.

(2) The public address system provides services like guidance, information, and emergency evacuation for passengers.

(3) The integrated display system provides guidance and information for passengers.

(4) The inquiry system provides passengers with inquiry services of guidance, information, announcement and other related information.

(5) The clock system provides unified standard time information for passengers and staff.

1.4 Other relevant monitoring systems

Some relevant subsystems as the electric power telecontrol, energy management, intelligent lighting are also installed in the comprehensive transportation hub to manage and monitor the power consumption of the hub.

(1) The power telecontrol system is mainly used for remote control, telemetry and remote signaling of all kinds of power facilities in distribution substations and power substations, which covers monitoring center host, integrated protection module, and remote terminal unit (RTU).

(2) Energy management system realizes all-round dynamic monitoring and recording of electric energy, which covers system host, data collector, and monitoring instruments.

(3) The intelligent lighting system controls the lighting facilities, including the host and the lighting control module in the lighting distribution box.

1.5 The integrated monitoring system

The integrated monitoring system



is an integrated automation mechanical and electrical equipment of the comprehensive transportation hub. By integrating or interconnecting different monitoring systems of the hub, the data of each system is integrated into a comprehensive information processing platform to provide business association and trigger linkages between each system.

2 Demands Analysis on Intelligent Requirements of the Integrated Transportation Hub

Currently, the comprehensive transportation hub can realize the monitoring of electromechanical equipment, fire control, power supply and video, and provide the fundamental services for passengers. However, each system is relatively independent,

resulting in repeated hardware construction and inadequate data sharing. Although the integrated monitoring system is set up to realize the integration of all the systems, it mainly focuses on the data collection and centralized display of each system, failing to meet the demands of intelligence. The breadth and depth of monitoring need to be strengthened. At the same time, what is absent is a unified coordinated management platform based on the analysis of monitoring data from the subsystems to guide production and operation.

The problems mentioned above together with demands from normal operations of the comprehensive transportation hub require updates to the level of the hub's intelligence in four aspects, namely: intelligent passenger service, intelligent control of mechanical and electrical equipment, intelligent operation and maintenance, and emergency management. Therefore,

more efforts need to be devoted to make full use of the information technology to guarantee more convenience for passengers, more intelligent dispatching and transportation, adequate and smooth information sharing, a safer and more efficient operation and a more environmental-friendly hub running. In this case, the goal of the green, intelligent and safe transportation can be achieved.

(1) Intelligent passenger service: By introducing the intelligent technology into the passenger service related system, the passenger service and management capacity of the comprehensive transportation hub can be effectively improved. For example, face recognition technology can be used to quickly identify people's identities; if combined with passenger service related systems, customized information can be precisely provided for passengers according to their travel needs and habits; Service robots can be in-

troduced to provide more flexible and active customer services; real-time monitoring and prediction of the hub's traffic flow can be performed to facilitate the work of the staff in the hub.

(2) Intelligent control of mechanical and electrical equipment: The intelligent mechanical and electrical system shall realize the unified monitoring and management, integrating systems including the mechanical and electrical equipment monitoring, automatic fire alarm and systems related with power supply monitoring and passenger service. The purpose is to safeguard a more rapid, flexible and unified linkage control. For example, in case of fire, the comprehensive system can perform a unified and intelligent control on automatic fire alarm, mechanical and electrical equipment monitoring, power supply monitoring and other related systems based on the outbreak location and real situation, which can make sure that the subsystems like air conditioning and ventilation, indoor water supply and drainage, escalator, and intelligent lighting can automatically switch to the work mode of fire.

More efforts need to be devoted to integrate systems of mechanical and electrical equipment monitoring, energy management and environmental supervision in a traditional comprehensive transportation hub, so that the hub has perfect perception and control ability for the environment and operation of those equipment, and further realizes intelligent energy-saving control. For example, the integrated systems, based on the status information of different equipment, can use the hub environment data to analyze the passenger comfort, establish relationship models among different equipment operation modes, station environment and passenger comfort, so that the hub can automatically adjust the equipment, such as lighting, ventilation and air conditioners after meeting the basic needs of passenger comfort, so as to achieve the most economic operation and in turn realize the purpose of green running for the hub.

(3) Intelligent operation and maintenance: The operation status data of

all kinds of equipment in the comprehensive transportation hub will be collected and applied to analyze their inherent parameters, operation data and industry data, thus acquiring information on abnormal in a real-time manner. It can then predict the service life of mechanical and electrical equipment, provide operation and maintenance plan, and meet the standard of full life cycle management and Condition-based Maintenance. In this case, the hub can perform intelligent operation and maintenance, and therefore ensure the safe and smooth operation.

(4) Emergency management: Different systems will be integrated into a unified emergency management platform to jointly resolve public emergencies. In case of emergency, the equipment and facilities in the hub will be uniformly dispatched, and be connected to the superior emergency management platform. During the emergency command, information can be queried and associated quickly. The intelligent data analysis, event database and association display will be used to provide auxiliary decision-making support for the staff. The connection with the outside system can help to guarantee the unified multi-disciplinary and cross-department command and coordinated action, so as to mobilize more emergency rescue forces, and improve the emergency response capacity of the comprehensive transport hub.

3 Intelligent Construction Solution of Xiong'an Integrated transportation hub

Xiong'an integrated transportation hub realizes the transfer of three modes of transportation: national railway, municipal transportation and urban rail transit. The municipal transportation projects will include taxi yard, social vehicle and network car parking lot, bus yard and long-distance bus yard. The goal in designing Xiong'an comprehensive transport hub is to build an important hub while integrating both the station and

the city and realizing zero distance transfer among different modes. As a collection of various transport nodes, Xiong'an Hub is the central nerve of traffic in Xiong'an new district featuring large passenger flow, high service standard, wide management range, great variety of operation types and great number of internal and external interfaces.

In order to meet the above intelligent requirements, the engineering construction should focus on strengthening the monitoring ability, building a unified system platform, enhancing the information sharing ability and building a coordination management platform based on data exchange. Furthermore, the intelligent design of Xiong'an comprehensive transportation hub shall also attach importance to its feasibility.

3.1 Composition of the Intelligent System

The intelligent system of Xiong'an integrated transportation hub mainly consists of three categories: special communication, integrated monitoring and other intelligent systems (see Table 1).

(1) The special communication system consists of local area network, telephone, wireless communication, video monitoring, integrated service management system (integrated coordination platform for traffic operation monitoring, public address system, intelligent integrated display, self-help and query, access control and patrol, intelligent operation and maintenance management, station navigation), clock, integrated wiring, vehicle management (taxi management, long-distance bus management, bus management and social vehicle management), power supply and grounding system.

(2) The integrated monitoring system involves mechanical and electrical equipment monitoring, automatic fire alarm, intelligent operation and maintenance of mechanical and electrical equipment and other mechanical and electrical systems, such as power telecontrol and intelligent lighting, so as to realize unified monitoring and management of these systems and linkage

Table 1 Overview of Main Intelligent Systems of Xiong'an Integrated Transportation Hub

Item	Systems	
Special Communication System	Hub LAN	
	Telephone System	
	Mobile Communication System	
	Video Monitoring System	
	Integrated Service Management System	Comprehensive Coordination Platform for Traffic Operation Monitoring
		Public Address System
		Intelligent Integrated Display System
		Self-help and Query System
		Access Control and Patrol System
		Intelligent Operation and Maintenance Management System
		Station Navigation System
	Clock System	
	Integrated Wiring System	
	Yard Management System	
	Power Supply and Grounding System	
Integrated Monitoring System	BAS	
	FAS	
	Intelligent Operation and Maintenance System of Mechanical and Electrical Equipment	
Other Intelligent System	Energy Data Acquisition System	
	Fire Safety Monitoring System	
	Water Supply and Drainage Centralized Control System	
	Waste Pneumatic Conveying System	
	Structure Intelligent Health Monitoring System	

control among various systems.

(3) Other intelligent systems mainly include energy data collection, fire safety monitoring, centralized control of water supply and drainage, waste pneumatic transportation, structure intelligent health monitoring system.

Unlike other integrated transportation hub, the one in Xiong'an has set up a comprehensive coordination platform for traffic operation monitoring and a navigation system in the station. An intelligent perception function is realized in the video

monitoring system, and an intelligent operation and maintenance system for mechanical and electrical equipment has been added to the integrated monitoring system. In addition, intelligent systems have also been installed for the corresponding disciplines of electricity, water supply and drainage, and structure.

(1) Comprehensive coordination platform for traffic operation monitoring. The platform performs the unified coordination, dispatching and controlling of all traffic management departments in Xiong'an comprehensive

transportation hub, therefore offering the optimal traffic guidance, providing information and automation methods for safe and efficient traffic operation, and realizing the goal of convenient passenger transfer, coordinated dispatching intelligence and smooth information sharing. See Figure 1 for the functional framework of the comprehensive coordination platform for traffic operation monitoring.

(2) Intelligent perception. The video monitoring system can realize the intelligent perception. An intelligent video analysis and monitoring platform is established to provide high-efficiency data access, stable storage, effective management and sharing services of video, image and other data for related businesses. The intelligent perception system uses the HD camera set in the comprehensive transportation hub to realize the functions of intelligent video analysis such as face recognition, passenger flow statistics, and abnormal behavior.

(3) Station navigation. Passengers can get access to the station navigation service via their own mobile terminals in the station.

(4) Intelligent integrated monitoring. The integrated monitoring system is characterized by the integration and interconnection with more intelligent systems, and the interconnection interface with mechanical and electrical intelligent systems such as energy collection, water supply and drainage centralized control system, waste pneumatic transportation, and structural intelligent health monitoring. The system aims at the full-time dynamic energy data collection of energy such as electricity, water and gas. Combining with the software analysis and control function of energy management system, the system can intelligently monitor and analyze the flow data of water meter, electricity meter and energy meter obtained from energy data collection. It can also intelligently monitor, analyze and control the power subsystem and lighting subsystem, and realize the dynamic monitoring of energy consumption data, energy consumption function analysis, report statistics, measures

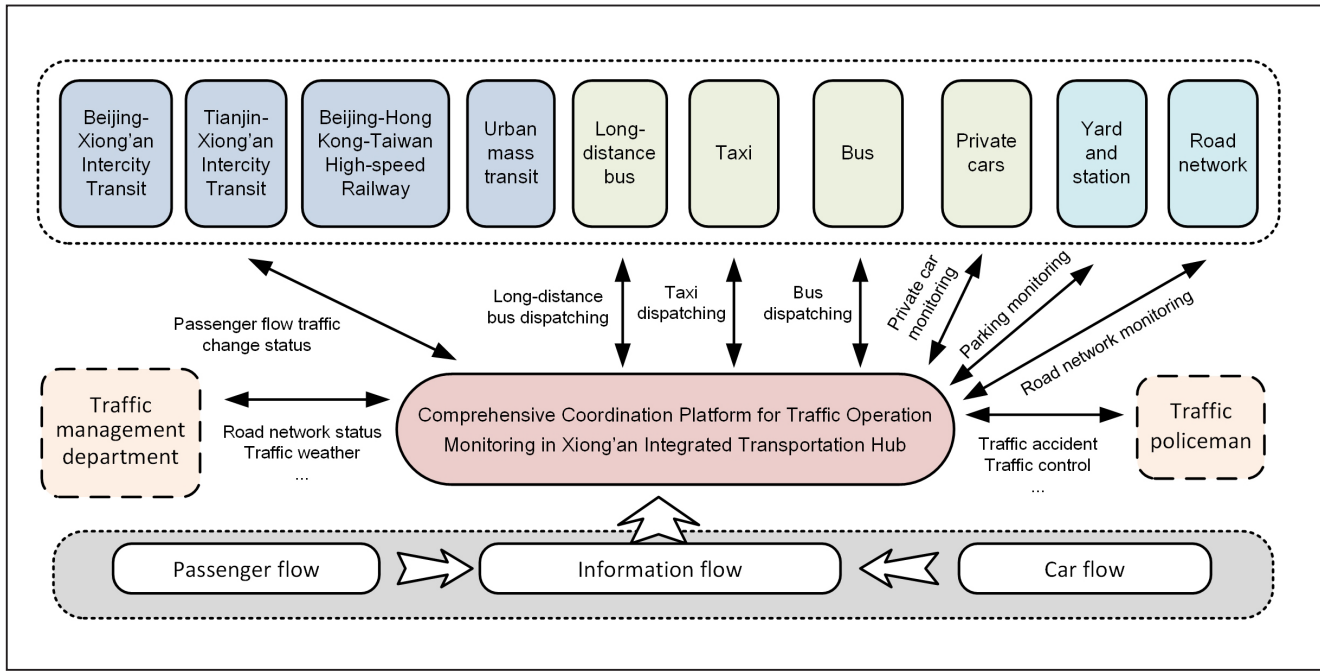


Figure 1 Function Framework of the Comprehensive Coordination Platform for Traffic Operation Monitoring

and suggestions, and graphic display. In this way, the system can control the operation parameters and perform the real-time and comprehensive monitoring and management of the whole energy chain of each energy consumption system in the hub. The intelligent operation and maintenance system of mechanical and electrical equipment collects the operation data of the

equipment, continuously monitors and inspects the operation status of the equipment and software systems for 7×24 hours. Thanks to the use of big data technology, the system can perform the whole life cycle management and Condition Based Maintenance (CBM) for the mechanical and electrical equipment.

(5) Other Intelligent Systems

① Fire safety monitoring system. The system integrates electrical fire monitoring and fire equipment power supply monitoring into one fire safety monitoring system. After integrating two systems into one, it collects operation data and alarm information of each subsystem, and is connected with automatic fire alarm system.

② Water supply and drainage cen-



tralized control system. The system is mainly responsible for the automatic operation control, state monitoring and operation management of different water supply and drainage equipment in the hub. The system is connected with the integrated monitoring system.

③ Waste pneumatic conveying system. The system uses air as the power to transport the waste from the building to the central collection station through the pipe network, so as to realize the complete closed collection and transportation of waste, meet the function of waste classification and transportation. The system is interconnected with the integrated monitoring system.

④ Structure intelligent health monitoring system. Through real-time collection and feedback of the relevant data of the service status of the structure, the system can locate the damages, decide its degree, evaluate the safety of the structure in time and effectively, predict the performance

change of the structure and give early warning of the unexpected events. By doing so, the system can fully master the evolution law of the stress and damage in the whole process of the structure construction and service, and the system is interconnected with the integrated monitoring system.

3.2 Technical implementation of intelligent system

To integrate different hardware equipment and build infrastructure for data sharing, a unified virtual cloud platform will be constructed in Xiong'an integrated transportation hub, so that the computing resource pool, storage resource pool, network and security equipment can be shared by systems including the integrated monitoring and intelligent operation and maintenance management, integrated coordination platform for transportation operation monitoring, intelligent integrated display, self-help and query, access control and patrol, intel-

ligent perception, video monitoring, yard management and other systems. Among them, the automatic fire alarm, mechanical and electrical equipment monitoring, public address, telephone and other systems are not included in the cloud platform temporarily due to their own equipment characteristics. See Figure 2 for the overall architecture of hub integrated cloud platform.

Based on the requirements of data collection, pooling and sharing, the plan of building a block data platform is proposed when designing Xiong'an terminal cloud platform. Block data is a data processing technology that deconstructs, intersects and merges traditional data through distributed import, distributed data storage and distributed computing, so as to fully explore the value of data and realize its comprehensive application^[9-10]. The cloud platform reserves the conditions for building block data application. With the gradual clarification of block data construction plan in Xiong'an

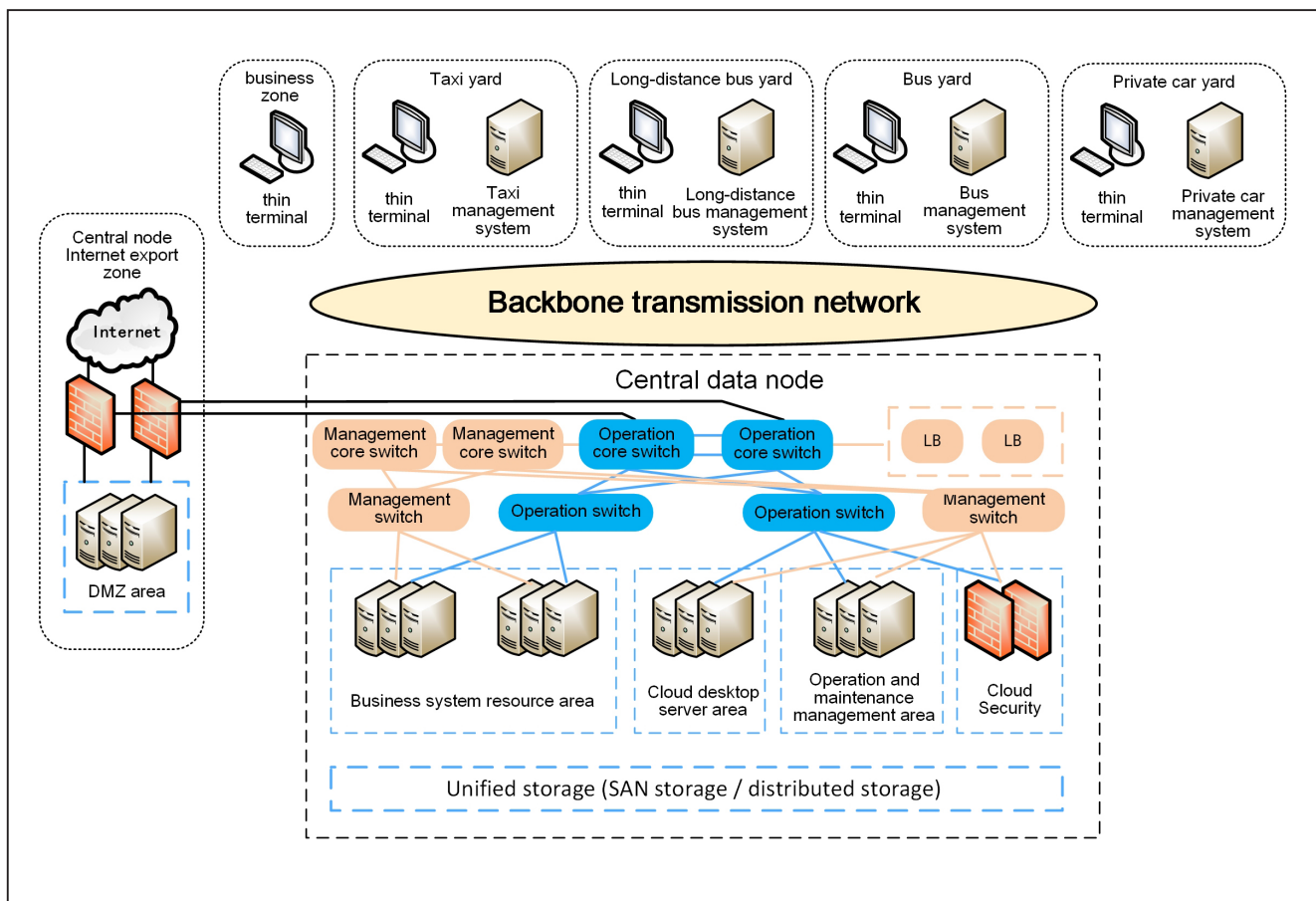


Figure 2 Integrated cloud platform of transportation hub

new district, the application resources, storage resources and block data construction and analysis software of the block data platform will be expanded in the virtual cloud platform of the comprehensive transportation hub.

Next, we will closely follow the release of Xiong'an regional information planning. After closely tracking the business requirements of the information system, we will apply block data platform to perform across-the-industry integration of systems of transportation operation monitoring comprehensive coordination platform, taxi management, long-distance bus management, bus management, social vehicle management, OA office and other relevant systems. Those efforts will help us, based on strictly following the Xiong'an informationization plan, in developing intelligent and integrated application, which is capable of performing actions identification, traffic

planning verification and optimization, user portrait, supply and demand analysis.

4 Conclusion

This paper analyzes the application status of mechanical and electrical equipment monitoring, automatic fire alarm, special communication system and other related monitoring systems in the comprehensive transportation hub. Based on the analysis, while combining with the requirements of the comprehensive transportation hub in terms of intelligent passenger service, control, operation and maintenance of the mechanical and electrical equipment as well as the emergency management, the establishing of the intelligent system for the comprehensive transportation hub is proposed, including the integrated traffic operation monitoring system, intelligent perception, station naviga-

tion, mechanical and electrical equipment intelligent operation and maintenance system and other intelligent systems. A unified hub virtual cloud platform will also be constructed. The system scheme can realize the interoperability of different kinds of intelligent systems, providing basic conditions for the application of Internet of things, big data and artificial intelligence. The system also reserves the conditions for the application of expansion block data. Subsequently, with the development of the overall planning of regional informatization, system construction and operation and maintenance requirements, the corresponding intelligent applications will be gradually improved.

(Translated by Zhou Yanfang)

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