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Design and Implementation of Intelligent Load Distribution Cloud Platform Based on Ant Algorithm

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Abstract

In order to solve the problem of chemical transportation safety and intelligent control, a smart high-speed solution based on the IOT intelligent control platform is proposed, and the overall framework is composed of '1+1+4'. Ant algorithm is embedded in the framework. Through parameter control of the ant colony algorithm, the transportation path can be optimized, which plays a role in risk dispersion in complex large and medium-sized road networks with multiple paths and nodes. The effectiveness of this algorithm has been verified through simulation experiments and actual data operation.

Keywords

Intelligent Load; Distribution Cloud Platform; Path planning; Ant Algorithm.

1. Introduction

Zhejiang is one of the most complicated regions in the country and even in the world in terms of road traffic, surrounded by mountains and complicated by hundreds of rivers running to the sea. The ancient trade routes and modern traffic are intertwined, and it has always been an accident-prone area in China. In addition, chemicals are flammable, explosive and toxic[1]. In the process of transportation, there are many factors that may cause dangerous accidents, such as overloading, failure to take safety measures, failure of vehicles and parts, drivers driving against the law, poor road conditions or weather conditions, etc., which may lead to collisions, overturns, etc., causing chemical spills, fires, explosions and other accidents. Standing at the historical intersection of the "two hundred years", the new plan should be based on the realistic consideration of solving the contradictions and problems in the industry, but also on the long-term strategic planning. In practice, the following issues need to be addressed[2].

(1) Delayed event detection, slow processing and weak full sensing capability

The quantity, quality and intelligence of the various sensor sensing devices in road construction[3] are far from adequate to meet the growing demand for operational management and services. The detection of traffic events is passive, and the response time to road safety accidents, disaster alarms and distress information is slow and the processing of events is sluggish.

(2) System linkage, data integration data mining level needs to be enhanced

The construction of intelligent control platform, operation requires links between all aspects of the subject. If the system lacks links, linkage is insufficient, the data lack of fusion mining analysis, can not be intelligent control of all aspects, scientific management[4].

(3) Use of inefficient, orderly traffic, poor environment

Many transport vehicles, passenger trucks mixed, large trucks occupy the road for a long time, resulting in poor traffic order, easy to accident, safe driving environment is poor. At the same time the big truck car load heavy, slow speed, affect the efficiency[5].

(4) Maintenance of scientific management level is not high

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Transport vehicles are numerous, the actual situation of each vehicle is also very different. Failure to maintain vehicles and parts in a timely manner can pose a great risk to travel. However, the digital testing of equipment is inadequate and lacks a scientific basis for maintenance. At the same time vehicle breakdowns and maintenance can have a direct impact on traffic safety.

2. General framework

In order to solve the problem of chemical transportation safety and intelligent control, a smart high-speed solution based on the IOT intelligent control platform is proposed, and the overall framework is composed of '1+1+4', as shown in Figure 2-1.

(1) Intelligent foundation setting

The development of communication system, the accuracy of Beidou/GPS is greatly improved, the development of 4G/5G technology, the popularity of intelligent hardware devices such as intelligent mini-stations, vehicle-road cooperation signal machines, gateways, etc., real-time transmission of the location of delivery vehicles is no longer a fantasy. The link between the various subjects is opened so that road accidents and natural hazards can be counter-controlled and harm reduced instantly.

(2) Digital support base

The "56168 logistics distribution digital intelligent control platform" has massive access to external vehicle information, carries intelligent applications, integrates digital twin engine, video analysis engine, decision algorithm engine, IOT intelligent control components, big data components, business support components and cloud platform, etc.

(3) Intelligent application scenarios

Based on the intelligent control platform, it realises the application of high-speed intelligent scenes, the application of intelligent service areas, the application of intelligent operation and maintenance, and the use of intelligent maintenance. Customized services are provided in scenarios such as road analysis, vehicle maintenance, vehicle tracking, vehicle positioning, service area reminding, active reporting, operation and maintenance analysis, travel services, and hazardous chemical control.

IoT Smart Control Platform is a one-stop IoT platform mainly integrating IoT, AI and digital twin, adopting distributed architecture and supporting I/O scale up to 10 million points. The platform takes IoT application scenario as the core, facing all kinds of IoT devices, providing ubiquitous IoT, digital intelligence modeling, digital plenum, intelligent algorithm, professional control and fast delivery capability, empowering the development of smart high-speed industry.

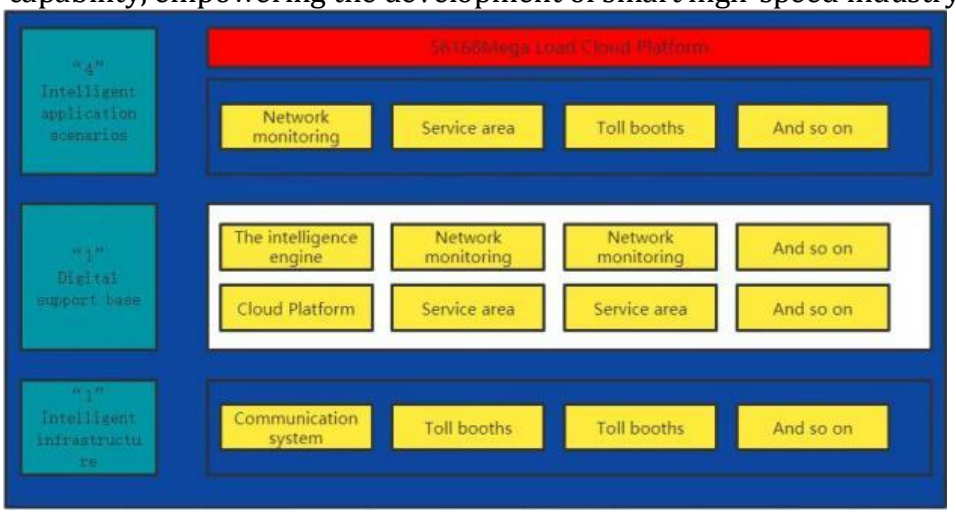

Figure 2-1 Project architecture based on the Smart Control Platform

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3. Smart Control Platform

56168 logistics distribution digital intelligent control platform is a full-sense control platform containing software, hardware and algorithms. As shown in Figure 3-1, the 56168 logistics distribution digital intelligent control platform contains the real-time status of waybills, quarterly distribution of major products, monthly product going map, annual product going map, total number of yearly waybills, total number of today's waybills, factory vehicles, platform operation status, alarm type statistics, number of members, supervised vehicles, annual distribution, driving personnel, route specificity and other functions. It reduces the difficulty of operation for operators and improves the fun of operation.

Figure 3-1 56168 logistics distribution digital intelligent control platform

(1) Monitoring and analysis of the entire road network

Open the "eye of God", holographic perception of transport vehicles in the main highway, interchange, smith road, tunnel and other road network road conditions, traffic events, vehicle trajectory and other information, display "a person, a vehicle, a road, an environment" dynamic simulation of the whole element, to achieve "(2) Lane level events

(2) Lane level event warning

To achieve the spill, vehicle stop, retrograde, speeding, low speed, continuous lane change and other events active discovery and accurate early warning, to support the follow-up rescue measures rapid linkage and departmental collaboration.

(3) Key vehicle control

For the two passengers and one dangerous vehicles, highway inspection vehicles, sweeping vehicles and other key vehicles, based on lane level positioning and mine vision fusion technology to achieve continuous tracking and full control of the target trajectory.

(4) Integrated traffic flow control

As shown in Figure 3-1, based on high-precision dynamic road network perception, traffic events are discovered at the second level, and recommended plans are generated through AI intelligent algorithms to assist high-speed monitoring centres to quickly issue traffic flow inducement and control plans, forming a collaborative linkage capability for the entire road network, supporting overall collaborative regulation and control, and ensuring smooth transport high-speed operation.

(5) Quasi-all-weather passage

For regional fog, group fog and other bad weather, based on video recognition, meteorological instrument monitoring, data services and other means, in the low visibility of the weather conditions accurately sense the state of traffic flow, real-time release of guidance information, speed limit information, open intelligent fog light, induce vehicles to slow down, safe passage,

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improve the level of safety of highway operation in bad weather, to ensure quasi-all-weather passage.

(6) Intelligent decision making and research

Big data convergence, processing, query and other aspects with strong computing capabilities. Data query efficiency has been improved from 10 minutes to seconds. It is equipped with functions such as evaluation of facility and equipment performance, traffic demand prediction of road network, analysis of short-time operation situation of road network and traffic risk analysis of road network. By controlling transport vehicles in transport and parks, the possibility of blockage is reduced and transport efficiency is improved.

(7) Emergency rescue management

Around the emergency rescue closed-loop management system, highlighting the various types of emergency resource management, data and information convergence, comprehensive command and dispatch and auxiliary decision-making and other support capabilities, to achieve the reporting of events, emergency command, disposal evaluation and other functions, to achieve the goal of "visible, callable, adjustable, controlled".

(8) Refined maintenance and operation

Through the vehicle maintenance digitalization and supporting equipment intelligence, combined with scientific maintenance AI predictive operation and maintenance algorithm, to achieve the distribution of transport refinement maintenance and operation and maintenance, improve management and maintenance efficiency, optimize the quality of service.

4. Promotion value of intelligent control platform

Smart control platform can unify and centralize the management of scattered business scenes through the industrial cloud, and empower traditional equipment IoT, help enterprises to go to the cloud, and complete the transformation from digital to intelligent enterprises. Through "equipment monitoring, maintenance services and optimization of operations", it realizes the whole life cycle management of equipment and enhances the remote operation and maintenance and service capability of equipment.

(1) Create big data analysis services for equipment operation and maintenance, and provide dynamic remote monitoring, analysis and pre-alerting of equipment system operation data through big data analysis technology to provide safety assurance for normal operation of equipment and production systems.

(2) Cloud-based remote operation and maintenance services, based on monitoring, alarms, logs, reports and other service tools to grasp the operational status of equipment, problems and faults and processing in real time, the system is supported by back-end remote technology to speed up the response time of fault alarms and continuously improve service quality.

(3) Through active operation and maintenance, fault warning and remote technical support, the system eliminates problems in the bud as far as possible to avoid the adverse impact of equipment failure on production and improve economic efficiency; through equipment big data analysis, it is equipped with a reasonable amount of spare parts inventory to reduce inventory backlog and lower operating costs.

(4) Through the statistical analysis of equipment energy consumption data, provide real and objective data information for the energy management system, provide data support and management measures for the enterprise to optimize energy structure, rational use of energy and energy saving, save energy and reduce production costs for the enterprise.

(5) Based on equipment online monitoring, fault diagnosis and early warning services, establish an intelligent equipment operation and condition assessment model, and establish corresponding assessment algorithms and standards to realize multi-parameter comprehensive

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monitoring and analysis of equipment condition, improve equipment operation efficiency and unit production capacity, and thus improve enterprise economic efficiency.

5. Optimization and innovation of ant algorithm

Starting from the risk analysis of dangerous goods transportation, this paper summarizes the current situation and development trend of the research on the optimization method of dangerous goods transportation at home and abroad, and analyses the main reasons for the occurrence of dangerous goods transportation accidents in China and the main risk factors affecting the transportation of dangerous goods in China. And on this basis, the Gaussian plume model is successfully applied to the diffusion range of dangerous goods. The impact of wind direction and wind speed on nearby residents and the environment in a short period of time when a dangerous goods spill occurs is fully taken into account. Transport methods are optimized and transport efficiency is improved.

The ant colony algorithm is a probabilistic algorithm used to find optimized paths. It was proposed by Marco Dorigo in 1992 in his PhD thesis and was inspired by the behavior of ants in finding paths during their search for food. The basic idea of the ant colony algorithm is derived from the shortest path principle of ants foraging in nature. Based on the observations of insect scientists, it was found that ants in nature, although not visually developed, can find the shortest path from the food source to the nest without any cue and search for the new optimal path adaptively after the surrounding environment changes.

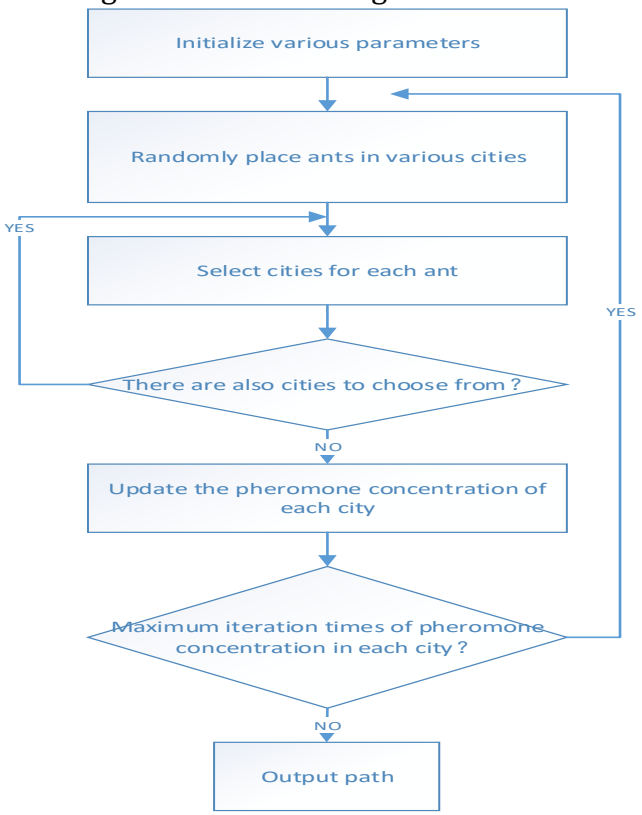

Figure 5-1 Principle diagram of the ant algorithm

The ant algorithm is an approximate algorithm that is not used to solve problems for which an exact valid algorithm already exists, but to solve problems for which no exact valid algorithm has been found so far. In the area of path optimisation, a multi-objective optimisation method is proposed that converts a multi-objective optimisation method into a single-objective optimisation method that gives an exact solution in small road networks where there are not too many paths. On the basis of the research on the route optimisation method for dangerous goods transport, two new models are proposed and established, namely the multi-path optional risk

dispersion model and the multi-discharge point decreasing risk model, taking into account the actual dangerous goods transport situation. In the multi-path optional risk dispersion model, the ant algorithm is applied to the path optimisation process, and appropriate improvements are made on the basis of the general ant algorithm, through the control of the parameters of the ant algorithm, so that it conforms to the characteristics of the risk accompanying dangerous goods transportation. It is suitable for medium and large road networks with more paths and nodes and a large amount of dangerous goods transported, and plays a role in risk dispersion. In the multi-discharge point risk reduction model, the actual carrying capacity of dangerous goods transport vehicles is fully taken into account to bring about the impact of transport risk, and the idea of secondary modelling is proposed in combination with the actual transport of dangerous goods at multiple demand points, which improves the accuracy of the algorithm and at the same time reduces the difficulty of the algorithm to a certain extent.

6. Summary

The new infrastructure is blowing hard and the digital wave is coming on fast. The construction of intelligent distribution transport has been accelerated. As the engine of the new infrastructure, intelligent transport will become a new economic growth point in the future. The IOT platform helps to develop the operation and control of smart highways in the direction of knowledgeable, measurable, controllable and serviceable through the monitoring and analysis of the whole road network and the control of the whole process.

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