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Exploration and Practice of Intelligent Monitoring and Analysis Technology in the Petrochemical Industry

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ABSTRACT

With the rapid development of computer vision, pattern recognition and other cutting-edge technologies, petrochemical enterprises have put forward higher requirements for intelligent monitoring capabilities. put forward higher requirements for intelligent monitoring capabilities in production and operation areas, in order to solve a series of pain points and difficulties such as insufficient on-site monitoring capabilities. difficulties such as insufficient on-site operation process monitoring, low real-time video transmission quality and security, and insufficient This paper analyzes the development status of video surveillance and analysis technology in the petrochemical industry, innovatively puts forward the development of video surveillance and analysis technology in the petrochemical industry. This paper analyzes the development status of video surveillance and analysis technology in the petrochemical industry, innovatively puts forward intelligent monitoring and analysis solutions, which are applied to a variety of scenes, can deeply drive the innovation and development of intelligent hardware, and realize the analysis and early warning of object activities within the visual range of On the one hand, it uses intelligent monitoring and analysis technology to dynamically analyze real-time data, and on the other hand, it enhances the uninterrupted detection and analysis of object activities within the visual range of multiple scenes. enhances the uninterrupted detection and control in the production area of petrochemical enterprises, which provides support for enterprises to realize intelligent management.

KEYWORDS

Intelligent monitoring and analysis technology; Computer vision; Pattern recognition; Digital Transformation

At present, China's petrochemical industry is facing serious challenges in the levels of energy consumption control and detection, data mining and analysis, production operation and management, intelligent automation, safety and energy efficiency and environmental protection, etc. Petrochemical enterprises should focus on optimizing and upgrading in the direction of comprehensive perception and integration of information, and move forward towards digital transformation and upgrading with the goal of constructing intensive, efficient, green and intelligent petrochemical enterprises.

Intelligent monitoring and analysis technology to help the digital transformation of the petrochemical industry, effectively guaranteeing that the massive real-time data returned from various application scenarios can be effectively monitored and analyzed. At this stage, for the various types of needs that exist in the petrochemical enterprises, in the cloud computing, Internet of Things, artificial intelligence and other new generation of information technology, intelligent monitoring and analysis technology can adapt to the new trend of development in the field of

digitalization, intelligence, intelligence, to accelerate the pace of digital transformation with the combination of hardware and software advantages to achieve the stable operation of the enterprise with high security, high requirements, high quality and high efficiency. Intelligent monitoring and analysis technology to solve the problem of artificial on-site monitoring and real-time on-site decision-making in the negotiation of the field operation monitor "see" "sense" to the information back to the data recognition monitoring and alarm platform, with a full range of massive data to support the intellectualized Transformation and upgrading. On the one hand, it can meet the urgent demand of enterprises for digital transformation and upgrading under the new normal situation, and comprehensively promote the management and service intelligence, production and operation digitization of petrochemical enterprises; on the other hand, it can drive the rapid development of high-tech and intelligent terminal applications, and drive the rapid growth of new business with new applications, new forms and new modes, so as to inject a powerful agent for the sustainable development of the petrochemical industry, and to promote the construction of smart factories (Yunzao, C. , et al,2009)

1 The business pain points of petrochemical enterprises on-site construction

At present, petrochemical enterprises have problems such as the monitoring range cannot be covered in all directions, the interaction efficiency of on-site operation is not high, the memory of special area operation is dangerous, there are blind zones in the network coverage of the plant, the real-time video return cannot be analyzed, and other business needs.

Firstly, The scope of supervision cannot be covered in all directions: there are a large number of temporary construction operations in the petrochemical zone with video monitoring blind zones, which require the supervision personnel to jointly supervise the whole process with software and hardware to solve the risks and hidden dangers in the safety construction and guarantee the safety construction.

Secondlt, On-site operational interaction is not efficient: companies need to monitor personnel to the site with paper or APP electronic work permit system for permit authentication, but the construction of many points, the distance often leads to each pre-construction invoicing time is extremely long. According to incomplete statistics, the construction team needs to wait for an average of about 1 hour before they can obtain the operating ticket to start construction, high time cost, difficult to maintain the equipment effectively.

Thirdly, Dangerous operation in special areas: When working in high towers, torches and other high places in the plant, the on-site supervisors will be in position together with the construction workers due to the requirement of real-time control. However, the working space itself is very narrow, and the personnel in position seriously occupy the working space resources, which in turn affects the construction operation in the area and is very likely to cause dangerous accidents.

Fourthly, There is a blind spot in the network coverage of the plant: enterprises mostly use the program of installing surveillance cameras to monitor the drilling, equipment in the plant area and other long-time construction, digging trenches, burying wires and other on-site operational processes make the program's construction costs and time costs are high. Although the traditional 4G wireless control ball can solve the problem of difficult wiring construction, but the 4G network bandwidth is low, it is difficult to protect the clarity of the monitoring video of multiple construction sites. On the market for the existence of monitoring blind areas of the single eye control ball, and most of the control ball does not have intelligent analysis function, still need to monitor and find problems.

Fifthly, Real-time video return cannot be analyzed: petrochemical zone operation scene is

different from other industries, due to the lack of a large number of case studies, database immaturity, and can not be mature AI image recognition technology applied to the petrochemical zone(Peng, W. , Yanchun, L. , & Weichun, H. 2019).

Sixthly, Multiple application scenarios need to be deepened: there are still a lot of gaps in field operations such as personnel identification, temperature detection, motion analysis, gas identification, violation identification, etc., which need to be extensively tested and analyzed in comparison. In the future, we need to fully consider the complexity of diverse application scenarios, carry out continuous research on intelligent monitoring and analysis technology for multiple application scenarios, incorporate temperature and gas statistics, improve and sound data collection and analysis, real-time automatic alarms, emergency handling, platform simulation and early warning, etc., and put in sufficient samples for training to enhance the interactive experience of the system and administrators.

2 Intelligent monitoring and analyzing solution

Intelligent monitoring and analysis solution takes the technical route of "data + platform + application" as the core, and through the AI algorithm model of the operation monitor, it analyzes and identifies the actual data collected in various application scenarios, predicts and warns, and transmits them back to the intelligent monitoring and analysis platform in real time, so that it can assist personnel in supervising and regulating the operation contents and guarantee the work safety of the construction personnel. Work safety. In accordance with the objective analysis of the petrochemical industry's demand for intelligent monitoring, PCCW proposes an intelligent monitoring and analysis solution that promotes the in-depth integration of computer vision technology and safe production operations management. The operation monitoring system itself is not only to promote the establishment of safe production operation management system, but also to realize the whole process of on-site inspection on the basis of deep data analysis, through intelligent algorithms to promote the whole process of monitoring and analysis of prediction and alarm beforehand, analysis and treatment during the incident, and summary management after the incident.

Computer vision technology itself should not only efficiently use machine vision for identification, but also quickly analyze the structured people, objects and scenes in complex application scenes, topology to the diverse operational scenes in the petrochemical zone, to achieve the purpose of monitoring and warning. At this stage, by investing in a large number of samples and cases, the intelligent monitoring and analysis system has allowed the equipment side and the platform side to train the data in accordance with the architecture, and to deeply learn the analysis and learning ability and behavioral thinking ability of the human brain, and to realize intelligent supervision with a new monitoring method.

Hardware layer, the use of intrinsically safe power supply to binocular focus, quadruple ring spelling, router using multiple power supply, self-developed ARM architecture, the overall architecture involves infrared image, zoom and fixed-focus functionality display; platform layer, by the analysis, identification, alarms composed of functional services, involving the design of the data flow and the management of basic data. The main idea is that the 5G intelligent monitor will access the primary captured video stream into the memory, and the existing intelligent monitoring and analyzing platform can access the video data in the memory and push it to the AI reasoning service and AI training service. The technology starts from the top-level design of petrochemical enterprises, adhering to the principles of openness, reliability, security and intelligence for construction, leaving API interfaces for new sub-systems, databases, functions and users in the

secondary development in the future, which can be extended to other systems except for the security system, and the synchronization of the use of advanced and mature technologies to meet the continuous development of the product.

3 Intelligent monitoring and analysis technology framework

Based on the new model of "data + platform + application", the intelligent monitoring and analyzing system vigorously promotes the industrial construction of application, industrial cloud, network, edge and all kinds of terminals, and the overall architecture is shown in the figure below.

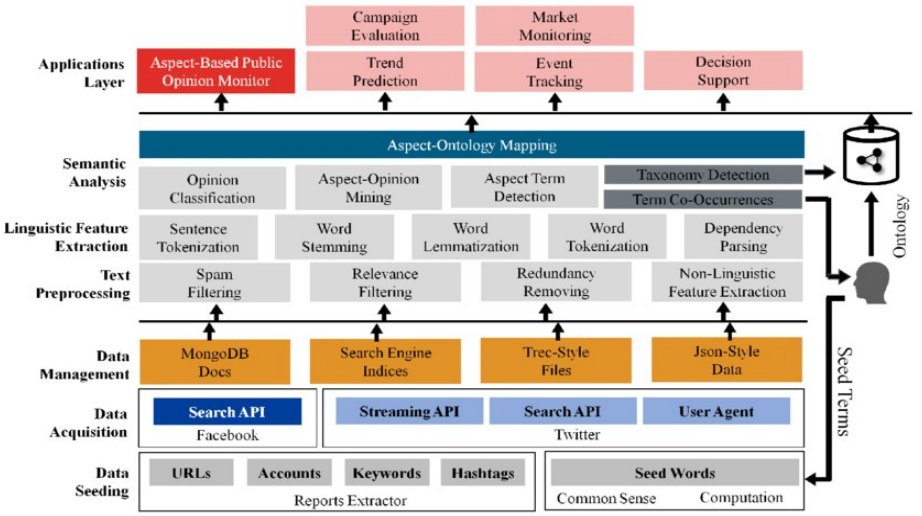

Figure 1 Overall Architecture of Intelligent Monitoring and Analysis System

The platform realizes timely coordination and processing of personnel control, environmental monitoring, accident emergency response and other business needs through panoramic analysis of on-site operation videos. Managers can guide the operation process according to the data fed back from the intelligent monitoring and analyzing platform, and warn and solve the abnormal situations such as wearing safety, boundary intrusion, falling objects and so on during the on-site operation. In addition, we can take the means of enhanced detection to deploy multiple devices to certain oil and gas leakage areas, key guardianship pump areas on-site, to carry out a dead-end, uninterrupted control, reduce the frequency of inspection by on-site personnel, and at the same time to meet the needs of safety management.

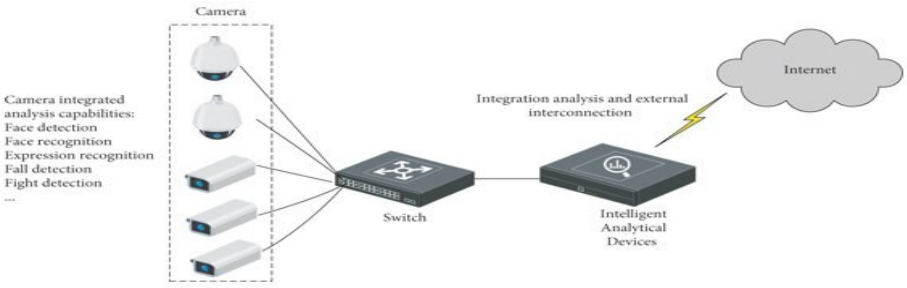

Figure 2 Architecture design of intelligent monitoring and analyzing technology

The platform system adopts spring-Boot-grpc architecture design, with "centralized management of the total platform and independent interconnection of sub-platforms" as the goal. The center of the total monitoring platform deploys the higher-level platform, and integrates the lower-level video convergence equipment through cascading to realize the transmission and interaction of control commands and video data. As shown in Figure 2, the core of the architecture design lies in the video integration capability, application expansion capability, network security performance and platform integration performance, through the platform to collect the distributed video highly unified management, to achieve the purpose of multi-party landing, multi-party sharing, multi-party collaboration. In this regard, considering the system platform capability, system analysis capability and system hierarchy design, the design team has carried out constructive planning to meet the actual needs while deepening the business.

System Platform Capability: The platform is based on the IP data exchange "high cohesion, loose coupling" way to complete the system aggregation, composed of large-scale distributed video integration system, to meet the multi-layer, multi-location, high concurrency system application requirements.

System analysis capabilities: AI inference analysis system, using high-performance GPU servers, with intelligent algorithms, able to carry out intelligent analysis of video surveillance in the hundreds of key location video. The platform is not limited to flame recognition, helmet recognition, overalls recognition, smoking recognition, cell phone recognition and other algorithmic analysis, the use of artificial intelligence technology to simulate the simulation of various types of behavioral actions of the existing application scenarios, to provide technical optimization support for the future, to improve the recognition rate.

System layer design: with PaaS layer and SaaS layer two core layers, PaaS layer is based on big data, cloud computing, AI technology system to undertake the construction of infrastructure, to solve the big data scenarios such as data access, storage, convergence, fault tolerance and other problems; SaaS layer is based on the ability to encapsulate the PaaS layer, the output of external industrialized value.

The application itself solves the strength and speed of dealing with abnormal response on the scene, reduces the probability of the occurrence of risks on the scene, and cooperates with the controlled system of the scene operation to achieve a better effect of on-site safety control. Among them, the web server nginx does reverse proxy, adopts MYSQL database, and makes the request distributed to the application server microservice cluster to achieve the purpose of load balancing.

Intelligent monitoring and analysis technology is based on the interaction of on-site operation monitor and enterprise system platform, which is able to integrate the functions of visualization front-end, AI data analysis, alarm and remote shouting, and retrospecting of abnormal events after the event, etc. With artificial intelligence and image processing related technology, it can automatically capture, intelligently identify, and quickly process the monitoring content to realize the monitoring and analysis of the irregularities of the operators and the abnormal events of the operating environment, and use the alarm light to warn the operator and analyze the situation, and use the alarm light to warn the operator. analyze, and communicate abnormal conditions such as gas leakage with alarm lights. Its service composition has six layers, as shown in Figure 3.

·Performance layer: the platform accepts the data transmitted by the user, and puts the interactive operation interface into the system operation, and finally displays the data to the user;

·Data exchange layer: the client can exchange data with the server through HTTP protocol, JSON, XML;

·Service support layer: Nginx application load balancing, Tomcat cluster that realizes high-performance load balancing, and micro-services based on system application modules expanded out to upload files to micro-services. Its biggest advantage is that most applications can call

computing resources more efficiently than traditional applications, also because they will break through the functionality bottleneck problem by extending the components;

·Service implementation layer: the main technology embodiment of the system;

·Data storage layer: the data storage layer mainly uses Redis and relational databases;

·Infrastructure layer: Tomcat application business service layer is composed of multiple small business unit microservices, different microservices will be distributed on different physical machine servers and will be deployed redundantly to achieve decentralization and ensure high availability of services.

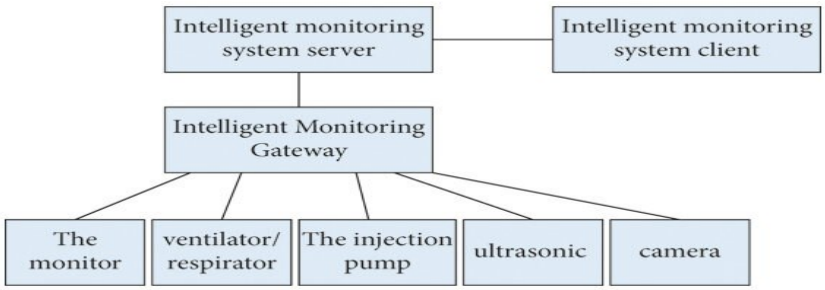

Figure 3 Service Composition of Intelligent Monitoring and Analyzing Technology

4 The value and significance of the program

At present, the independently developed and applied production operation area monitoring model has played an important role in the enterprise. The platform is based on hardware terminals, which can automatically identify and abnormally alarm labor protection dress, personnel behavior, fire, light and smoke, and border intrusion. Compared with the effect of traditional monitoring equipment, the recognition accuracy of open fire within 5s under 10*10 pixels reaches more than 85%; the recognition accuracy of labor protection dress and personnel behavior under 30*30 pixels reaches 85%.

The core value of intelligent monitoring and analysis solution is to match the development direction of smart factory through innovation, and to lay a joint foundation of highly efficient and interconnected software and hardware for the digital transformation of enterprises. Currently, the construction of intelligent monitoring and analysis solutions is aimed at designing a service architecture that is suitable for application scenarios in petrochemical zones. The platform layer comprehensively analyzes information after gathering data from the hardware layer, and ultimately, it is not limited to image analysis algorithms, but also builds mathematical models for deep learning of behavioral recognition and other contents, so that the specific information formed can help managers remotely analyze the on-site conditions and assist enterprises in decision-making.

5 Enterprise Practice Achievements

The first 5G intelligent monitoring station in the petrochemical industry solves the problem that construction site safety monitoring cannot be efficiently and accurately supervised in the petrochemical zone, and meets practical business needs such as AI intelligent identification, gas sampling analysis and monitoring, and guarantees the safety of on-site operators and installations. At the same time, the low-latency technology of 5G explosion-proof private network enables the terminal to realize massive data acquisition and intelligent analysis, further enhancing the level of

industrial safety.

Figure 4 5G Intelligent Guardian Station

PCCW's 5G Intelligent Guardian Station has assisted Tianjin Petrochemical, CNOOC Huizhou Petrochemical, Inner Mongolia Xinte Silicon Materials Company Limited, Fujian Wanhua Chemical Company Limited, and many other companies to conduct on-site monitoring operations. 5G public network signals in the plant have been tested and stabilized, and the current equipment, gateway + AI platform have been successfully deployed and applied at the customer's site. Among them, in the construction of CNOOC Huizhou Petrochemical Intelligent Factory, PCCW's 5G Intelligent Guardian Station product supports Telecom's 700MHz band dedicated network, helping the enterprise to reach a standardized and intelligent production operation safety guardian mode, with good feedback from the enterprise.

Figure 5 Tianjin Petrochemical Site

Figure 6 CNOOC Huizhou Petrochemical Site

6 Summary and Prospect

At this stage, with the deep integration of artificial intelligence, computer vision and other technologies with the petrochemical industry, the addition of intelligent monitoring and analysis technology will gradually become the key to digital transformation. Intelligent monitoring and analysis technology development and application should be closely integrated with the development of cutting-edge technologies, advanced video surveillance technology and image processing technology integration, applied to the petrochemical enterprises in the production and operation area of the diversified scenes, and ultimately high-definition intuitive, dynamic capture of the image information in a timely and efficient manner in front of the staff and decision makers on duty, for petrochemical enterprises to provide a strong protection and support of production safety, therefore, the intelligent monitoring and analysis technology has a great potential. Therefore, intelligent monitoring and analyzing technology has great research value and application prospects (Xiaodong, C. , et al, 2013).

The petrochemical industry uses intelligent monitoring and analysis technology as a means to build an interconnected, resource-sharing visualization supervision platform and emergency response center, centralize the management of resources, form a shared, collaborative, safe production and operation mode, enhance the enterprise's on-site perception, data intelligence, interconnectivity breadth, and achieve sustainable development. In this context, we will take unified standards, unified planning, and deep integration of computer vision, pattern recognition and other technologies into the platform to help petrochemical enterprises realize digital transformation and upgrading.

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