Advancements in Customs Operations: Harnessing the Power of AI and 5G

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Abstract: *Security inspection stands as an indispensable facet of routine customs operations, assuming a central role in ensuring the overall efficacy of the process. Conventional customs inspection procedures have long grappled with issues such as exorbitant costs, protracted decision-making timelines, and cumbersome processes, rendering manual inspections unsuitable for the contemporary demands of customs operations. Capitalizing on the maturation of 5G and artificial intelligence (AI) technologies, innovative and efficient solutions have emerged to address the intricacies of customs security inspections. This article delves into the underlying theories and practical applications pertaining to the integration of 5G and AI technologies in the realm of customs security inspections. Through a comprehensive examination, it aims to shed light on the challenges inherent in existing customs technologies while concurrently offering a theoretical framework that substantiates the application of these cutting-edge technologies in the forefront of customs security inspections.*

Keywords: *Customs; 5G; AI; Security Check*

1. Introduction

In recent years, there has been rapid development in emerging information technologies such as big data, the Internet of Things (IoT), and artificial intelligence (AI). Technological progress is now aligning with the concept of "what you think is what you get." In the realm of smart customs construction, a strategic focus has been placed on the deep integration of emerging information technologies and cutting-edge equipment. This approach aims to achieve intelligent customs management, analysis, service, and operation, ultimately optimizing customs supervision services and enhancing modern governance capabilities.

Reference [1] proposes the development of a customs remote guidance visual inspection system based on the integration of Augmented Reality (AR), 5G, and AI, denoted as "AR+5G+AI". This innovative system utilizes AR intelligent collection devices and leverages mobile edge computing through the 5G network. The primary objective is to assist customs security personnel in conducting inspections efficiently. Data collected by AR smart wearable devices is transmitted to the intelligent center (backend server), where relevant policies are promptly formulated based on the specific circumstances. This streamlined process significantly reduces reporting time and enhances the overall efficiency of customs inspection procedures for personnel. The new operational mode for remote guidance visual inspection involves import and export cargo consignees or their agents applying for customs inspection. The customs inspection department then formulates an inspection plan, employing an automatic dispatch system for random assignment of inspectors. Inspectors assess whether remote inspection conditions are met based on declaration information. If within the scope of remote inspections, inspectors register for remote inspections and engage with on-site personnel from enterprises through a remote inspection system to ensure high-quality transmission and prepare for inspections. Following the confirmation of job details, inspectors conduct inspections according to instructions from the management system. Video recordings of remote inspections are saved, and results are recorded in a new management system. In cases where conditions for remote inspections are not met or if an inspector deems it unsuitable for remote examination, on-site inspections are carried out as an alternative.

2. 5G technology

5G network is the latest generation of mobile communication network, utilizing fifth-generation cellular mobile communication technology [1]. Its main driving force comes from the mobile internet

and artificial intelligence. Faced with an ever-increasing amount of information transmission, higher data transfer speeds have become an urgent demand. Enhanced mobile broadband offers ultra-high reliability and low latency characteristics, meeting China's vertical industry needs based on the Internet. Compared to 4G technology, 5G technology has achieved comprehensive improvements in eight key capabilities: peak rate, user experience rate, spectrum efficiency, support for mobility, time delay, and number of connections per unit distance. In the field of customs administration, 5G technology has already been successfully applied by utilizing wireless communication (such as AGV communication) to achieve automated security inspection services. Through means like RCMS business and video surveillance, it has expanded the information coverage scope of security inspection operations and met practical requirements.

The system operation modes outlined in reference [2] offer two deployment options: public cloud and private cloud service clusters. Comprising front-end, application clusters, and an intelligent center, these options include modules such as data interfaces, load balancing, allocation units, and general components. Object recognition modules, indoor navigation, industrial assistance, and label recognition contribute to the functionality of application clusters. Supporting filtering frameworks and optimization frameworks adaptable to real-world scenarios, the system's sensors feature AR glasses for customs scene learning and depth perception. Utilizing the Simultaneous Localization and Mapping algorithm enables environment analysis. The platform layer, inclusive of machine vision platforms, audio-video processing, deep learning, and big data analysis modules, also integrates 3D interaction, rendering engines, and environmental understanding. Complex computations are facilitated through Multi-access Edge Computing (MEC). The backend comprises command platforms, management platforms, and automated data interfaces, supporting remote guidance for customs personnel, data access permission management, and data interaction interfaces. The intelligent center's database storage is segmented into auxiliary databases, application databases, system databases, audio-video databases, and remote connection devices, meeting the storage requirements for the entire process inspection data during remote guidance [3-5].

The advent of 5G technology has ushered in a new era of connectivity, enabling faster and more reliable communication. Paired with the capabilities of artificial intelligence, this technological synergy empowers customs agencies to revolutionize their security inspection protocols [6-8]. The integration of 5G facilitates real-time data transmission and communication, overcoming the delays associated with traditional methods. Simultaneously, AI algorithms enhance the analytical prowess of customs inspections, swiftly processing vast datasets to identify potential security threats.

In exploring the theoretical foundations, this article scrutinizes the symbiotic relationship between 5G and AI, elucidating how their convergence amplifies the effectiveness of security inspections. Moreover, it probes the practical application scenarios wherein these technologies can be seamlessly incorporated into customs operations. From advanced scanning techniques to predictive analytics, the article examines the spectrum of possibilities afforded by the amalgamation of 5G and AI in augmenting the precision and efficiency of security inspections [9].

An integral aspect of the discourse involves a meticulous analysis of the impediments currently faced by traditional customs technologies. High costs and time-intensive procedures have long been Achilles' heels in the realm of customs inspections, necessitating a paradigm shift towards more technologically advanced solutions. By dissecting these challenges, the article seeks to underscore the imperative need for the adoption of 5G and AI technologies in customs security inspections.

Enhancement of Customs Inspection Efficiency: The implementation of a new inspection model has brought about a substantial improvement in customs inspection efficiency. Prior to adopting this model, customs officers were constrained by the need to physically visit enterprises for on-site inspections, resulting in a limited number of daily inspections. However, the introduction of the new model has significantly increased efficiency by allowing customs to receive advance information about goods arrivals, enabling the formulation of inspection plans proactively. With customs officers now able to virtually experience the inspection process through remote monitoring, qualified goods can undergo "inspection upon arrival, immediate release, and use." This innovative approach not only expedites the inspection process but also ensures comprehensive documentation and video records throughout. The efficiency gains achieved with this streamlined model surpass previous methods by more than five times. A comparative analysis of field enforcement inspections conducted by Jinpu Customs in 2019 and post-implementation of the new model suggests substantial savings for businesses in terms of labor costs, transportation expenses, and administrative fees.

Reduction in Business Costs: Before the adoption of the new model, enterprises faced the logistical

challenge of shuttling between customs and inspection sites, consuming significant manpower and resources. The introduction of the new model simplifies this process, with enterprise personnel now equipped with AR smart glasses provided by customs. Advance notification of inspection plans allows for mutual agreement on inspection times, eliminating the need for enterprises to physically visit customs sites. This streamlined inspection mode not only reduces business costs but is particularly beneficial during times of COVID-19 prevention and control measures. The simplified process accelerates the resumption of work and production for enterprises while concurrently cutting down on expenses.

Evolution towards Intelligent Regulation: The regulatory landscape is undergoing a paradigm shift towards greater intelligence, marked by the deployment of our independently developed patented product, the AI smart glasses 'Cloud Eye.' This cutting-edge technology surpasses traditional AR glasses in functionality and performance, delivering more accurate, intuitive, and intelligent regulation. The introduction of 'Cloud Eye Check' represents a groundbreaking customs inspection mode, signifying a significant milestone in achieving smart regulation. This mode minimizes offline communication among personnel, fostering efficient online management and exchange of electronic data. The dedicated information platform enhances the convenience of regulation, ensuring traceability of law enforcement information and maintaining complete records of the enforcement process. The integration of technology and business in this manner heralds a new era of intelligent and streamlined customs regulation.

3. Artificial intelligence

Artificial intelligence (AI) technology constitutes a sophisticated mathematical modeling technique, drawing inspiration from the intricate neural synapses of the human brain and aptly referred to as neural networks [2]. In this paradigm, computational models emulate the intricacies of biological neural networks, forming intricate structures composed of numerous nodes and connections. Each node signifies an output function conditioned under specific circumstances, and the connections mimic the transmission of weighted signals, akin to the memory processes observed in artificial neural networks [3].

The efficacy of artificial neural networks in producing diverse network outputs is heavily reliant on the interplay of weight values, activation functions, and various connection methods. This type of computational network exhibits remarkable speed in processing real-world functions, expressing logical strategies analogous to algorithms and functions inherent in natural systems. The construction of artificial neural networks is fundamentally grounded in biological principles, drawing insights from research into the functionality of human and other animal nervous systems. Rooted in mathematical statistics, this technology has undergone optimization to enhance learning methods, thereby becoming a specific and practical mathematical statistical operation in everyday life.

When applied in the operational context of power distribution networks, artificial intelligence, specifically in the form of artificial neural networks, proves invaluable. By leveraging mathematical statistical standards and analytical methods, it aids personnel in acquiring extensive local spatial data. This application holds significant implications in the realm of maintenance, facilitating a more informed and efficient approach. Moreover, in the field of artificial intelligence, particularly within power distribution networks, the technology supports diagnostic experts in obtaining abundant data. Through rigorous mathematical statistical analysis, it ensures precise and accurate results, thereby continuously elevating their perceptual capabilities.

The integration of statistical methods during the diagnostic process contributes to the improvement of decision-making abilities and judgment awareness. This approach effectively replaces traditional manual repair solutions. Furthermore, the utilization of big data streamlines the detection process, enhancing convenience and speed while concurrently minimizing errors attributable to manual calculations. In essence, the effective application of artificial neural networks in fault detection within power distribution networks aligns with the demands for logical thinking ability and the precise standardization processing of diverse data types. It furnishes maintenance experts with robust data support, ensuring a more accurate and efficient detection process [10].

This article seeks to establish a comprehensive theoretical foundation for the seamless integration of 5G and AI technologies within the realm of customs security inspections. Through a systematic exploration of theoretical frameworks and practical applications, it aims to shed light on the transformative nature of these advancements. The overarching goal is not only to effectively address

existing challenges but also to lay the groundwork for a customs inspection framework that is characterized by enhanced efficiency, cost-effectiveness, and responsiveness.

By delving into the theoretical constructs underpinning the amalgamation of 5G and AI, the article aims to elucidate the synergistic effects of these technologies. It endeavors to demonstrate how the convergence of 5G's high-speed connectivity and AI's analytical capabilities can revolutionize traditional customs operations. In navigating through these theoretical foundations, the article provides insights into the intricacies of their integration, emphasizing the potential to overcome longstanding limitations and inefficiencies in customs security inspections.

Moreover, the exploration extends into the practical applications of 5G and AI technologies in the context of customs operations. By examining real-world scenarios and use cases, the article illustrates how these technologies translate theoretical advantages into tangible benefits. The focus is not only on mitigating challenges but also on proactively reshaping the customs inspection landscape, fostering a paradigm shift towards a more streamlined, adaptive, and cost-efficient approach.

The synthesis of 5G and AI technologies is portrayed as a heralding of a new era in customs operations. This paradigm shift signifies a departure from traditional methodologies, where the twin goals of efficiency and security are brought into convergence to meet the dynamic demands of a globalized landscape. The article underscores how this synthesis serves as a catalyst for transformative change, positioning customs operations to navigate the complexities of modern cross-border trade with heightened efficacy and resilience.

4. Conclusion

In summary, this article endeavors to bridge the gap between theory and practice, providing a robust foundation for understanding the integration of 5G and AI in customs security inspections. It envisions a future where the harmonious interplay of these technologies not only resolves current challenges but also ushers in a new era of customs operations that is characterized by heightened efficiency, cost-effectiveness, and adaptability in response to the intricacies of the globalized trade environment.

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