The Application of Internet of Things Technology in Equipment Management of the Armed Police Force

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Abstract. The Internet of Things, as an important component of the new generation of information technology, is a common trend applied to equipment management in the People's Armed Police Force. This article explores the application of Internet of Things technology in the intelligent management of the People's Armed Police from the perspective of weapon and equipment management.

Keywords: IoT technology, equipment management, big data, and data analysis.

1 Introduction

The Internet of Things is the third wave of the development of the world's information industry after computer science, the Internet and mobile communication networks[2]. It has been highly praised and developed by countries around the world. At present, China's Internet of Things technology has gradually been applied and matured in various fields such as security, electricity, transportation, logistics, healthcare, and environmental protection[1]. The People's Armed Police is an important component of China's military, and achieving intelligent management in daily work is an important guarantee for improving military combat effectiveness under modern conditions. Especially in the place where it happened.

After disasters such as earthquakes, floods, and severe tropical storms, communication network facilities may be partially destroyed, resulting in the inability to instantly grasp the presence and operation status of equipment ahead through fixed networks. It is necessary to use the mobile and convenient Internet of Things to achieve real-time, continuous, and accurate on-site monitoring and control of important equipment used, in order to ensure the smooth progress of emergency tasks or rescue operations[12]. Relying on the internal network of the military, we develop supervision system software with data collection, analysis, fusion, and visualization technology as the core. The system collects equipment information through a forward pointing wireless sensor network and transmits it in real-time to the base pointing control center through the military intranet, enabling higher-level departments to timely grasp the distribution and usage of equipment and provide data support for military decision-making. After the system is deployed and applied, it can ensure the safety and efficiency of equipment management[14], and improve the command and decision-making ability of the troops.

The widely recognized concept of the Internet of Things is defined by the International Telecommunication Union (ITU)[4], which uses information sensing systems such as radio frequency identification, infrared sensors, global positioning systems, and laser scanners to

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intelligently connect things to T2T (Thing to Thing), people to Things H2T (Human to Thing), and people to Human H2H (Human to Human) according to agreed protocols for information exchange and communication[3], in order to achieve intelligent identification, positioning, tracking, and more A network for monitoring and management. The Internet of Things technology was first applied in military material management. With its integration and development with military networks, its advantages are not only reflected in the logistics field, but also in military reconnaissance, environmental monitoring, unmanned combat, and other aspects[5]. For example, based on emerging software and hardware technologies such as IC cards, RFID, and wireless sensors, an intelligent supervision system and management system for weapons and equipment are constructed. The Internet of Things has a huge impact on military information construction, But in order to truly achieve wider applications, there are still many problems that need to be solved urgently, such as standardization issues, information security issues, etc. At present, the application of China's Armed Police Force in this field is rapidly developing in four directions: real-time battlefield situation awareness, intelligent weapons and equipment, efficient command capabilities, and precise logistics support.

2 Equipment Management Structure of the Armed Police Force

(1)Equipment management function of the People's Armed Police Force

The difficulty of managing military equipment is shifting from managing a few core level equipment to managing general intelligent equipment with a wider range of applications. The new equipment management model requires supervision of the entry and exit status, in place application status, and further promotion of information automatic collection and management in the storage, regular inspection, repair, retirement, and other stages of key equipment used in field operations such as duty and emergency response[6]. The battlefield equipment safety supervision system needs to address the security supervision issues of important military equipment data in mobile environments, achieve full time controllability and traceability of equipment, and meet the following equipment management functions of the military: based on RFID electronic tag technology, timely registration of equipment entering and exiting the battlefield environment is achieved; Utilize multiple types of sensors to collect equipment operation status data and transmit it in real-time to the equipment control console[5]; The equipment console realizes cleaning, filtering, fusion processing, secure storage, and warning reporting of monitoring data; Utilize the internal network of the military to gather data on forward pointing equipment to the base pointing data center, achieving real-time monitoring, statistical querying, and visual management of equipment; The system is deployed at the headquarters, headquarters, and support teams to achieve automated management of the entire lifecycle of equipment.

(2)Overall architecture of the equipment management system of the People's Armed Police Force

The battlefield equipment safety supervision system consists of an RFID tag set, specific sensor monitoring nodes, and communication and data processing software. The system combines wireless radio frequency (RFID) technology, intelligent sensor network technology, and wired communication network technology to quickly build a hybrid military Internet of

Things with wireless ad hoc networks as the periphery and military command intranet as the backbone under harsh outdoor conditions. The system cooperatively perceives, collects, and processes information on specific equipment objects within the network coverage area through monitoring nodes, achieving various functions such as automatic registration of important equipment, automatic monitoring of critical equipment operation status, forward pointing equipment positioning, monitoring, and alarm.Data from multiple predecessors is collected, processed, and presented through the military command network at the base, achieving full lifecycle management of battlefield equipment.

3 Application Construction of Armed Police Equipment Management System

The Armed Police Equipment System consists of two parts: the front equipment supervision console and the base equipment supervision center console. The former refers to the equipment supervision console, which realizes the safety control of equipment in the battlefield environment, including the RFID electronic tag management subsystem, environmental monitoring subsystem, and intelligent analysis subsystem. The Jizhi Equipment Supervision Center mainly realizes the full lifecycle automation management and real-time monitoring of equipment.

3.1 IoT Hardware

Select RFID tags that meet military standards, handheld and fixed RFID tag readers and writers as equipment certification management equipment; Select ZigBee wireless module, as well as temperature, humidity, smoke, sound and other sensors as wireless sensor network data acquisition equipment to build the hardware platform of the battlefield equipment supervision system[7].

3.2 Equipment Management Platform

The tag management subsystem consists of an RFID tag issuance module, an RFID tag recognition and collection module, and an RFID tag information application module, which are interconnected to jointly achieve the equipment tag management function. The RFID tag information application module runs on the front monitoring console and is the core of equipment management. The RFID tag issuance module is a prerequisite for the entire system, and the RFID tag recognition and collection module is the foundation and means to achieve management functions. The system reads tag information through handheld devices (PDAs) or fixed card readers, and identifies, collects, and stores RFID tag data through serial (or network) communication[9].

Wireless sensor nodes are distributed in the areas that need to be monitored (such as front field tents equipped with various important equipment), conducting data collection, processing, and wireless communication. The aggregation nodes receive data from sensors bound to the equipment and transmit the data to the upper computer (computer) in a wired manner. The information collected by sensors can include temperature, humidity, light intensity, sound, and atmospheric pressure. The upper computer receives data through a serial port (achieved through USB to serial port) and hands it over to the intelligent analysis module for processing.

3.3 Intelligent Data Analysis

Intelligent data analysis processes various events and parameters related to equipment in the application environment, such as temperature, humidity, light intensity, sound, etc., analyzes their changing trends and the causes of abnormal data in real time, and provides timely warnings or appropriate disposal suggestions. It includes four modules: data storage statistics, analysis and diagnosis, scheme input, and alarm perception, which respectively realize various functions such as statistics, analysis, diagnosis, and suggestion. This system provides data interfaces for equipment management, environmental monitoring, and safety management subsystems, and stores important data submitted by other subsystems in a data repository.

The data storage integration and analysis section consists of a database, data fusion algorithms, and scheme input submodule. In addition to the data storage mentioned earlier, the database section also includes a trend library and an abnormal event handling method library. The data storage library and trend library are linked within the module. The alarm perception module is responsible for real-time monitoring of accident alarms discovered by other systems and receiving the processing results of the diagnostic analysis module. The diagnostic analysis module will immediately analyze the cause of the accident using the data from the trend library after analyzing the occurrence of the accident, and provide the most reasonable solution with the assistance of the abnormal event handling method library. After alarm perception, it will be sent to the display module for interaction with management personnel[15].

The working principle of hierarchical data storage is based on the locality of data access. By automatically moving infrequently accessed data to lower levels of storage, freeing up higher cost storage space for more frequently accessed data, better overall cost-effectiveness can be achieved[13].

Using pointer recognition technology to accurately analyze big data on IoT platforms, in order to better understand its features and patterns. The distribution of big data mining pointers on IoT platforms is shown in Figure 1.

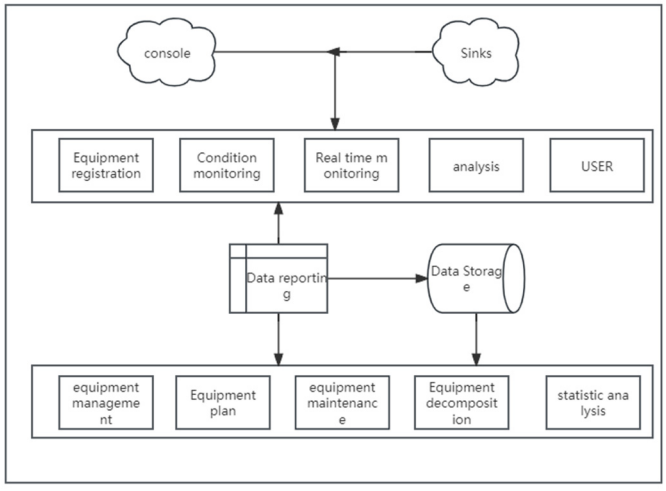

Figure 1 Distribution of Big Data Mining Pointers on IoT Platforms

By using the data mining methods shown by the pointer distribution above, it is possible to accurately locate big data in the platform by partitioning blocks. Based on this, a big data mining information query module and an information storage module for the Internet of Things platform can be constructed to extract statistical features of big data in the platform and finely mine platform big data.

By using feature matching methods to cluster fuzzy information in big data of IoT platforms, and using semantic segmentation technology to construct a weighted learning model, effective management and optimization of big data can be achieved, improving its adaptability. By using fuzzy adaptive classification information, the adaptive weighted learning situation is determined, and based on this, combined with the characteristics of the adaptive weighted big data space, a big data fuzzy weighted learning formula for the Internet of Things platform is constructed[11]. The obtained spatial clustering model is shown in formula (1):

$$\begin{aligned} \dot{x} &= \sigma x + \sigma y \\ \dot{y} &= -xz + rx - y \\ \dot{z} &= xy - bz \end{aligned} \quad (1)$$

Among them, x, y, and z respectively represent the semantic similarity feature information of big data in the three-dimensional space of the Internet of Things platform; B is the ambiguity coefficient in data mining, σ Set of semantic ontology; R is the rough feature matching set. By constructing a fuzzy weighted learning approach, the platform's ability to adaptively mine big data can be improved.

4 Application of Armed Police Equipment Management System

In the process of weapon and equipment management, the application of Internet of Things technology can annotate location information and device information through new communication protocols and broadband wireless networks, effectively achieving device mobility management and real-time monitoring of device movement and distribution status. In addition, installing complex sensors in the equipment can also achieve real-time monitoring of the warehouse output and warehouse related parameters, and make personalized adjustments according to the military's task requirements to ensure the efficiency of military task completion[10].

The management of weapons and equipment of the People's Armed Police can be divided into static management and dynamic management. Static management mainly involves the management of weapons in equipment warehouses, while dynamic management refers to the management of weapons and equipment during use.

The management of weapons and equipment in the arsenal can be achieved by installing RFID tags on the weapons and equipment, achieving functions such as outbound goods, storage, querying, and intelligent reminders[8].

Outbound management of weapons and equipment: The RFID reader automatically perceives the information of weapons and equipment, and the biometric device automatically determines the information of the personnel using the weapons and equipment. The legitimacy of delivery is determined based on the usage program of the weapons and equipment and the user level at the time of delivery. Satisfy delivery conditions, allow delivery, automatically record weapon delivery time and personnel information, update the database in real time, if the outbound conditions are not met, an alarm will be triggered.

Weapon Equipment Inbound Management: Quickly read weapon equipment information through RFID readers, determine storage locations through comparison of database information, so that weapon equipment can be placed in designated storage areas, and the database can be updated in real-time.

In the dynamic management of weapons and equipment, wireless sensor network technology can be used to dynamically monitor the technical status, movement status, and distribution position of weapons and equipment, and provide real-time alarms for weapons and equipment that have not left the field, providing scientific decision-making basis for the timely management of the battlefield dynamic status of weapons and equipment by the commander of the People's Armed Police Force.

5 Conclusion

Building a military equipment management system can achieve automated management of equipment throughout its entire lifecycle, effectively solve safety monitoring and management issues of battlefield equipment, provide the working environment and operational status information of battlefield equipment for various levels of command institutions in the military, improve the combat effectiveness and command decision-making ability of the military, accurately grasp the battlefield situation, and better fulfill their responsibilities and missions.

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