

## The Managing and Scheduling System for the Disaster Rescue Equipment of PAP based on the Internet of Things

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### Abstract

By utilizing the technology of the internet of things and computer network, the problems of armed police in the perception, RFID, networking and interconnection etc have been solved accordingly and the set of managing and scheduling system for the disaster rescue & relief equipment of armed police was also developed. While the natural disaster occurred, it can realize the effective scheduling of the emergency rescue equipment depending on such system, so as to improve the ability of the armed police in disaster rescue and emergency treatment, guarantee the timeliness of the emergency response and to carry out rescue work rapidly and effectively.

### Keywords

Internet of things; Disaster rescue&Relief; Equipment; Radio frequency identification (RFID).

### 1. Introduction

Through the application of the technology of internet of things in the management of disaster rescue & relief equipment, the intelligent and scientific management and scheduling on the disaster rescue & relief equipment shall be realized, meanwhile the effective management on the emergency rescue equipment can also be performed during the daily maintenance and management procedure on the disaster rescue & relief equipment; while there's accident, through the reasonable and scientific scheduling on the emergency rescue equipment, it can improve the rescue efficiency and lower the casualties and asset losses to the largest extent.

Based on the current three-tier network owned by the armed police, by combining the relative technology of the internet of things, a set of management information system on the disaster rescue & relief equipment of armed police was developed to realize the digital and effective management on the emergency rescue equipment.

### 2. The system composition and principles

#### 2.1 Sub-section Headings

The management information system on the emergency rescue equipment based on the internet of things mainly consist of RFID active electronic tag attached to the rescue equipment, RFID reader, the three-tier network of armed police, data server, the satellite network of armed police, monitoring computer, the management software for emergency rescue equipment etc, as per shown in Fig.1. This system can perceive the information of emergency rescue equipment through the intelligent node attached to the emergency rescue equipment and then upload the information to the upper RFID reader via self-networking and wireless method, through the emergency communication network the RFID reader then store the received induction data in the data server for data processing, the data server will store the induction data as the real-time data at the first time, then reflect them as the relationship data through relational mapping and store them in the relational database; the management information system on emergency rescue equipment that deployed in the monitoring center or on-site rescue commanding and scheduling center shall analyze and process the data stored in the relational database, and carry out the management of emergency rescue equipment and the application of emergency rescue scheme etc. [1]

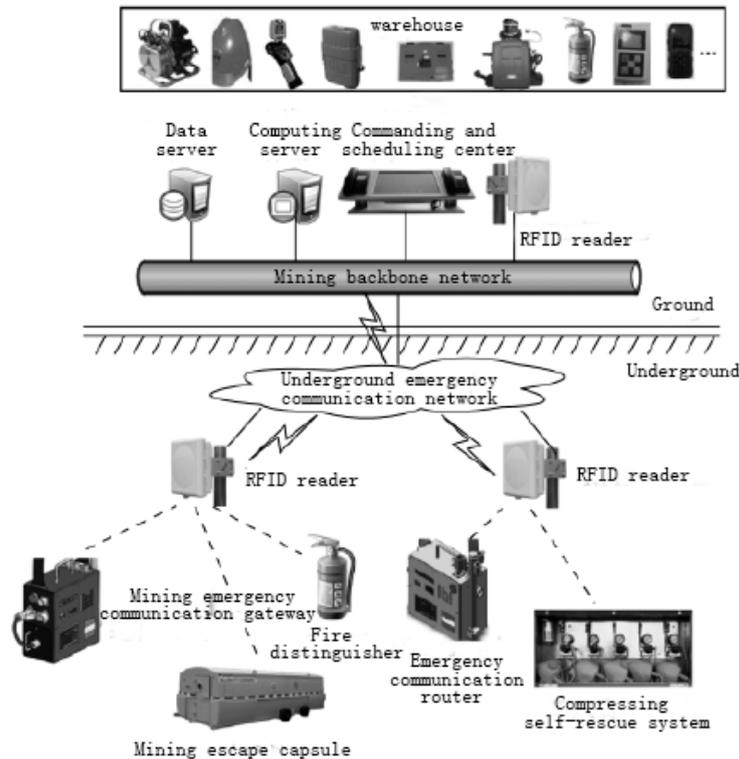


Fig.1 System description

During the accidental emergency rescue process, it can rapidly search, locate and call the existing emergency rescue equipment through such system and carry out the emergency rescue work accordingly. In addition, this system can also assist the relative operator to complete the daily management and maintenance on the emergency rescue equipment.

### 3. The system and software architecture

#### 3.1 The system architecture

The system architecture of the management system for the mining emergency rescue equipment based on the technology of the internet of things consists of perception layer, network layer and application layer as per shown in Fig.2.

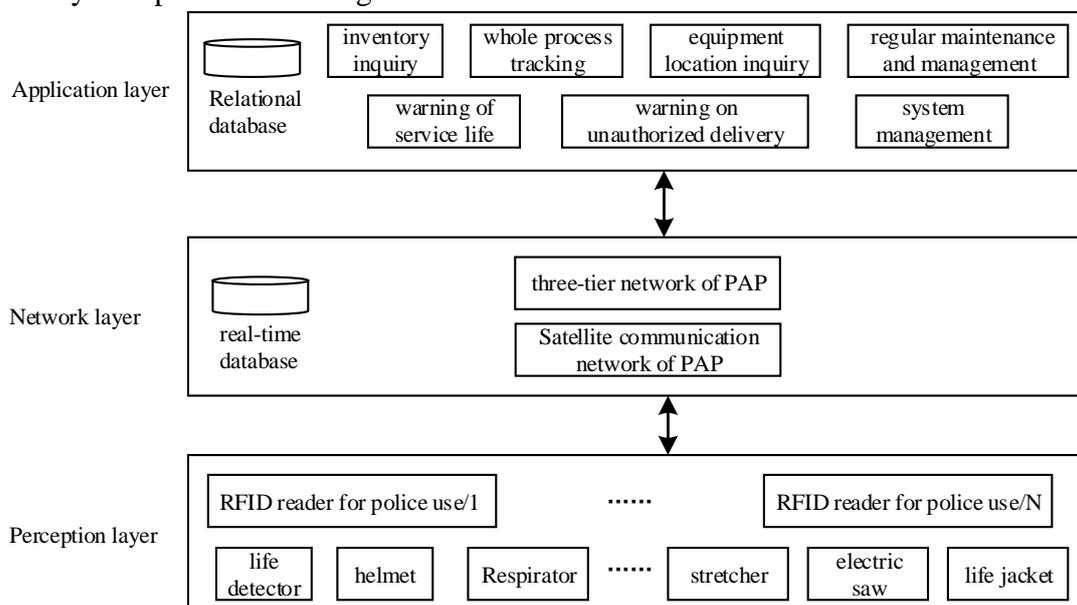


Fig.2 The system architecture

The perception layer is the foundation for the management system of emergency rescue equipment. It was mainly used to acquire the sensing data from various of emergency rescue equipment, as the data perception is the center of the internet of things. Each mode in the perception layer is the intelligent sensing node, the intelligent node could perceive the information and upload the information to the upper RFID reader through self-networking, the FRID reader will submit the collected sensing data to the application layer through network layer for processing. The perception layer mainly acquire the digital information of those emergency rescue equipment through the RFID electronic tag attached to those emergency rescue equipment such as escape capsule installed in the warehouse, the compressing self-rescue device in the refuge chamber, fire distinguisher, respirator etc [2].

The network layer mainly take in charge of the transmission of management system for mining emergency rescue equipment, it was established at the emergency communication network and mining backbone network, mainly contains the functions of real-time storage, network management etc. The network layer shall transmit the various data received from the perception layer to the matching data processing center through the mining emergency communication network and the three-tier network of armed police for processing by the application layer. The application layer is the most top module for the management system of emergency rescue equipment, is mainly used to realize the data relationship storage, inquiry, analysis, mining, understanding of the sensor data, and the application and decision-making based on the sensing data, thereinto the distributed data processing technology based on cloud computation is the main technology of the application level.

**3.2 Software platform**

The primary design concept for the management system software architecture of the mining emergency rescue equipment based on the technology of the internet of things is based on the object-oriented module design thinking, it used the multi-threading technology and the distributed processing technology based on cloud computation as per shown in Fig.3.

Based on data application	
Middleware	
Data buffer area	real-time database
Data receiving module	date filtering module

Fig.3 The software platform

The lowest layer are the data filtering modules and data receiving modules. The data filtering module mainly collect the concerned original data of the user according to the prior set filtering configuration information, to relieve the pressure of server and bring convenience for user’s data analysis. The data receiving module mainly receive the sensing data of various rescue equipment acquired by the perception layer.

The data buffer area is used to buffer the data detected by the sensor temporarily, the middleware will take data out of buffer area and call the real-time data processing module to store the data into the real-time database and relational database according to the certain storing format. The real-time database is used to solve the massive data storage problem detected by the detectors, the concurrency and real-time properties of real-time database guaranteed the integrity, real-time and liability properties of the data.

The top layer shall be the application layer, through the real-time data of emergency rescue equipment detected by the perception layer, it can upload the monitoring data to the application service platform in real time after the relational process, the application service platform shall compute and analyze the detected real-time data,carry out relative management and application accordingly. The system functional modules are shown in Fig.4 [5].

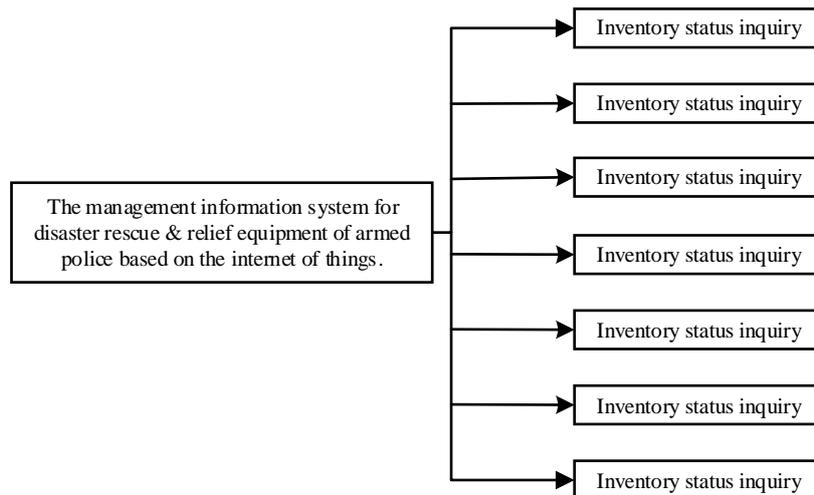


Fig.4 The system functional modules

These modules consist of the inquiry on equipment inventory status, the whole procedure tracking on the inventory, usage, maintenance, dumping of the equipment, inquiry of equipment location, regular verification alarm, warning on the service life expiration, warning of unauthorized delivery and system management etc. With such platform it can assist the emergency commanding center or temporary commanding basement to perform the effective deployment and allocation of rescue resources and strength, to guide the emergency rescue, help investigating the accident, lower the casualties and asset losses due to the disaster and accidents, etc.

#### 4. Main key technologies

##### 4.1 The perception and RFID of emergency rescue equipment

The perception and RFID shall be the foundation for the management information system of emergency rescue equipment, its technology shall also be the core techniques of the internet of things. For there shall be confrontation and conflicts among the wireless accessing and reading/writing behavior of the RFID tags attached to several emergency rescue equipment at the same time, there may be some cases that one tag was covered and wrote by several readers simultaneously, or one reader shall cover and read several tags at the same time etc. The first situation shall be the interference problem between several readers and one tag, as per shown in Fig.5.

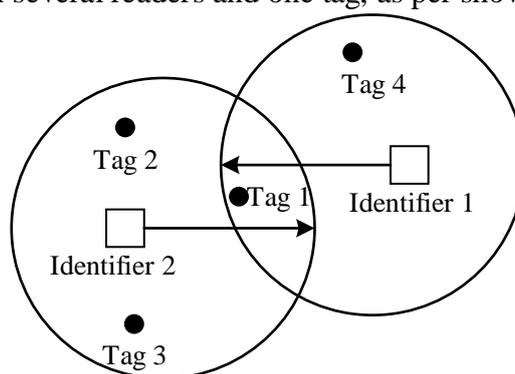


Fig.5 The diagrammatic sketch for the interference between multiple readers and one tag

It's quite similar as the radio broadcast method while the reader reading/writing the tag, there are several tags to receive the information sent by one reader at the same time. The communication of that several tags transmitting their own data to the reader at the same time is regarded as multiple access, it may easily cause the RF interference and conflict, currently there are 4 different methods to solve such problem: the methods of time division multiplexing, frequency division multiplexing, space division multiplexing and code division multiplexing. At present the "ALOHA anti-conflict algorithm" shall be one of the relative matured algorithms, with such algorithm it can effectively solve the information conflict problem among different electronic tags.

#### 4.2 The networking and interconnection of emergency rescue equipment

In order to transmit the information of emergency rescue equipment acquired by the perception device, it may use the industrial Ethernet technology, CDMA and M2M technologies etc, to transmit the perceived information of emergency rescue equipment to the data server and application layer in real time with effectiveness, reliability and safety. The system concerns to the transmission platforms such as wireless sensing network, the three-tier network of armed police and the satellite communication network etc, how to utilize the several network platform to transmit the information of emergency rescue equipment to the network layer and application layer in real time with liability, this shall also be one of the key technical problems such system need to solve accordingly.

#### 4.3 The information management on emergency rescue equipment

First of all, by focusing on the realization of the three functions of the internet of things like “overall perception, reliable transmission and intelligent processing”, this system comprehensively utilizes the sense technology, multiple sensor integrating technology, the wireless network of armed police and built-in system to complete the information acquisition and pretreatment of emergency rescue equipment, and transmit the information to the information center via the satellite network or the three-tier network of armed police accordingly.

Secondly, by using Client/Server network structure and ADO controls to access the remote SQL Server relational database, so as to realize the real-time update of the information during monitoring process in the content of database. In order to accommodate to the digital and information requirement on disaster rescue & relief of armed police, the monitoring unit was integrated with the information management at the monitoring end of the management center of emergency rescue equipment, by integrating the mining network and Internet/Intranet technologies to realize the seamless connection between the armed police’s emergency communication network and TCP/IP information network accordingly. The system uses the server/ client three-tier network architecture based on the internet, the monitoring center can acquire the on-site data information in real time and also realize the shared emergency rescue information resources accordingly.

The last is the realization of system application functions: each emergency rescue equipment was attached with the active RFID electronic tag, correspondingly the RFID reader was also set in each detachment and the entrance of each warehouse. While the emergency rescue equipment passing through the signal coverage range of the reader, the reader then acquire the information of such rescue equipment through the electronic tag attached to the goods. A number of RFID readers were also set at the exits of detachment, warehouse and magazine and the the entrance of detachment, to track the information of rescue equipment out of the warehouse, so as to realize the information management and tracking on all the operation procedures such as the automatic identification, positioning, inventory, usage, maintenance, delivery, dumping etc while emergency rescue equipment entering into warehouse and leaving detachment.[6]

### 5. Conclusion

In this paper it explored such a feasible method to realize the management information system of disaster rescue & relief and emergency rescue materials by utilizing the technology of the internet of things, and developed the set of management information system for the disaster rescue & relief equipment of armed police. The system basically realized the information management on the emergency rescue equipment and the perception and processing on the disaster rescue & relief equipment etc, on one hand it can assist the soldier to carry out the daily maintenance and management on the emergency rescue equipment; on the other hand, it can improve the emergency response and treatment ability of armed police while facing to the natural disaster and accidents, guaranteeing the effective execution of rescue work and the emergency response in time, reducing and lowering the casualties and asset losses caused by the occurrence of the accident. In addition, the system also provide such a new type of information and intelligent platform for improving the ability

of armed police on the management of disaster rescue & relief equipment and emergency response accordingly.

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