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Design and Development of Measuring Instrument Management System based on Article Coding and RFID for Mandatory Verification Use

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Abstract. This paper discusses the design and development of measuring instrument management system based on article coding system for mandatory verification use. The main principle is to perform the article coding of each unit of measuring instrument for mandatory verification use through a scientific coding system. With the implementation of the article coding, the accurate positioning of instruments for mandatory verification use is achieved. Furthermore, the processes including purchase, use, traceability, supervision, law enforcement, suspension, scrapping, the whole process of transfer and the comprehensive real-time monitoring can be realized.

1. Introduction
The system of mandatory verification has been implemented in China for 30 years and it has always come with the serious problems such as "unclear basis", "weak supervision", "concealment, omission, failure to report, refusal of verification and use at overdue cycle", etc. The fundamental problem lies in the inability to make the measuring instrument for mandatory verification accurate, and thus failing to realize the process monitoring of its entire life cycle. With the extensive use of article coding and radio frequency technology, it provides possibility solve this problem. In this paper, the principle, methods and steps of using article coding for the dynamic supervision of measuring instruments for mandatory verification use. [1]

2. Application significance of article coding and FRID
There are five attributes that determine the uniqueness of a measuring instrument: the name of the use unit, the name of the instrument, the model and specification, the manufacturer, and the factory number. In terms of a piece of instrument, the difference of merely one word in these five attributes would lead to the inaccurate retrieval of the instruments in the system. While in practical work, such information is generally filled out by the customer who submitted for inspection, and is then input in various systems. Among them, there are a large number of non-standard inputs such as abbreviations, aliases and common sayings. Moreover, the correct matching update rate is less than 30%, which led to the repeated filing of the same measuring instrument and multiple updates as well as the massive redundant data, thus eventually resulted in the loss of the regulatory effectiveness of the measuring instrument for mandatory verification. However, the article coding and FRID technology enable each instrument to have its own ID card and the uniqueness of identifying the equipment. The utilization of
the unique coding can achieve the tracking management of the full life cycle and the whole process of instruments.

3. System Design
The system frame diagram of instrument management system based on article coding and RFID for mandatory verification use is as shown in Figure 1.

![System Frame Diagram](image)

Figure 1. System frame diagram

By adopting J2EE technology, a three-tier model thinking based on MVC is established, and SqlServer is functioned as the main database of the system. In the aspect of core algorithm, the system uses the periodical division model of measuring instruments firstly, and utilizes RFID (radio frequency identification) technology and precise positioning instruments of hand-held terminals. The life cycle and the use process of the measuring instruments are analyzed to solve the issues of measuring instruments in respect of all the objective procedure and the implementation time in the activities. The
system then uses the text word segmentation technology and DFA-based keyword matching technology to analyze the mandatory verification data of measuring instruments, so as to abstract the characteristics and attributes of various activities of measuring instruments. Finally, the system establishes the similar characteristic model for the mandatory verification business of all measuring instruments and engages in the mandatory verification business matching problems through the characteristic model matching between the instrument weekly inspection activity and the institutions, and then carries out the relevant inspection business through the public platform (online application, online approval, online inspection submission, progress query, etc.), and the push of information message.

Based on the traditional software development process, the system uses the UML modeling language to conduct the activities from the blueprint analysis of users’ needs, demand use case analysis to the general design, detailed design and database design of the system. Moreover, the detailed analysis and modeling are conducted for the key technologies used in the system. The multi-threading technology is used for data concurrent processing and analysis, and parallel data warehouse technology is adopted to solve large data storage and data fast retrieval, so as to improve the data quality at the same time. [2]

3.1. Establish unified information data source for organizations
By centering on the Chinese integrated coding of three-certificate-in-one, the user information of measuring instruments for mandatory verification is unified and standardized to prevent the ambiguity of user information.

3.2. Structure of article coding
By relying on the global uniqueness of the article coding, for the instruments printed with the factory article coding, they should be filed at the metrological administrative department from the retailer and entered into the market for circulation; for the instruments without the article coding, they should be given the temporary coding by the metrological administrative department before circulating in the market. The existing equipment should be numbered according to the specific circumstances. The structure of coding is as shown in Table 1.

| Item          | Header | Filter Value (F) | Partition (P) | Vendor Identification Code (C) | Commodity Item Code (I) | Serial Number (S) |
|---------------|--------|------------------|---------------|--------------------------------|------------------------|------------------|
| Binary Digit  | 8      | 3                | 3             | 20~40                          | 24~4                   | 38               |

Header: An 8-bit binary value that defines the total length, identification type and structure of the code.
Filter value: it is used to quickly filter and determine the basic logistics unit type
Partition: it indicates the separated position of the subsequent Vendor Identification Code and the Commodity Item Code.
Vendor Identification Code: it is identical with the corresponding GTIN Vendor Identification Code, which is expressed in binary.
Commodity Item Code: it is an indicator that connects GTIN with the Commodity Item Code, and both of which is combined as an integer and converted to binary as the Commodity Item Code field for SGTIN-96.
Serial Number: it is an integer number, and is within the range of the valid serial number specified by the GS1 system.

The measuring instruments shall be coded to ensure the information uniqueness of the instruments. The database is connected to establish relations for further access the information including specification and model, factory number, measurement range, accuracy level, traceability records,
maintenance records, complaint records, nonconforming records, corporate integrity records level and so on.

3.3. Read Vector Design
In actual use, the two-dimensional bar code or RFID suitable for its characteristics shall be selected as a vector of reading according to the factors including the value, size, importance, work environment and so on of measuring instruments one by one.

The reading vector of measuring instruments is standardized by establishing the corresponding relation table of uniqueness guarantee vector (Table 2) of various instruments in the mandatory verification directory, so as to facilitate the actual needs of measurement. [3]

| Item Number | Item Category | Identification vector of factory requirements | Identification vector of follow-up supervision |
|-------------|---------------|---------------------------------------------|--------------------------------------------|
| Electrocardiograph and Electroencephalograph | One-dimensional or two-dimensional bar code | RFID |
| Electrocardiograph | One-dimensional or two-dimensional bar code | RFID |
| Electroencephalograph | One-dimensional or two-dimensional bar code | RFID |

3.4. Article coding information base of measuring instrument for mandatory verification use
He user shall apply for the article coding online for its measuring instruments used for mandatory verification. The following information shall be supplemented after obtaining the article coding;

(1). the basic information of instruments includes instrument name, model specifications, manufacturer, serial number and installation position,

(2). the information of measurement characteristics includes verification parameters, measurement range and accuracy level

(3). the previous verification information includes the last verification organization, verification time and the next verification time.

The utilization of article coding realizes the global precise positioning and life cycle supervision of the instruments for mandatory verification work.

3.5. Record management of measuring instrument for mandatory verification use
According to Article 5 of the Management Measures for Verification of Measuring Instruments for Mandatory Verification of the People's Republic of China, the instrument users shall apply for filing to the metrological administrative department of the local people's government at the county (city) level through this system. After the metrological administrative department verified the authenticity of the information submitted, it shall make the record management. Meanwhile, it shall also print the FRID label with mandatory coding information. Since this label contains all the information for this instrument, the instrument users can pick this label from the metrological administrative department and paste on the corresponding instruments. In that way, the coding record process comes to a completion.

3.6. Cycle verification management of measuring instrument for mandatory verification use
Similarly, according to Article 5 of the Management Measures for Verification of Measuring Instruments for Mandatory Verification of the People's Republic of China, the instrument users shall
apply for periodic verification with the metrological administrative department of the people's government at the county (city) level through this system, so that the metrological administrative department can specify the designated or authorized measurement verification agencies to perform mandatory verification tasks according to the metrological verification agencies automatically matched in the system and by following the principle of economic rationality and in-place and nearby position.

After the metrological verification agencies accepted the task of mandatory verification, the system will notify the instrument users by means of SMS, WeChat, e-mail, etc. to send the instruments to the designated agencies. The instrument users shall send the measuring instruments for mandatory verification with FRID labels to the designated agencies, and specify the agency to scan the FRID labels and obtain the article coding information. After the verification is completed, the data is connected through the system and the internal management system of each metrological verification agency. The article coding is functioned as a link to realize the data exchange and update between the system and the internal management system of various metrological verification agencies, thus realizing the automatic updating of verification results. [4]

3.7. Supervision of measuring instrument for mandatory verification use
The metrological administrative department reads the FRID label to obtain the article coding and the instrument supervision information through the handheld terminals. In order to achieve the dynamic supervision of the measuring instruments for mandatory verification, the information access by manual input is implemented for those places cannot be implemented with direct reading such as gas station and so on.

3.8. Site Verification Terminal
By holding the handheld terminals, the verification personnel can conduct the receipt of on-site verification samples, and then print customer information and sample information so as to paste them in the original record. Therefore, it reduces the filing amount of on-site records.

3.9. Public Services
By using the mobile phone APP, the general publics are able to be clearly aware of verification and violation conditions of each measuring instrument, and understand the integrity status of merchants, and they can report and comment on any behaviors of measurement violations. The consumers can also conduct a simple verification by using the mobile phone as a verification standard. The system will automatically collect such information to further improve the integrity archives and increase the costs of measurement violations.

3.10. Implementation Process
A total of five aspects are involved in this system, which includes the users of mandatory verification instruments, measurement supervision department, FRID label printing department, metrological administration department and the general public. The specific implementation process is shown in Figure 2.
4. Conclusion and Outlook
Firstly, according to the information characteristics of the measuring instrument, the code of the organization is proposed as the main line for the method described in this paper, and the idea of taking the article coding as the instrument uniqueness guarantee vector is put forward; the tracking and management of the full lifecycle of instruments are realized through the precise positioning of instruments by using the FRID technology and application of the handheld terminals; Secondly, the unified standardization, automatic matching and intelligent error correction of data are realized through the establishment of association between compulsory verification basic database and the data. At the same time, the mandatory verification management is extended to the technology level to eliminate the issues such as over-range verification and so on. Thirdly, the functions such as online applications, online approval, online inspection submission and progress query, etc. are achieved through the design of the management system. Fourthly, the real-time updating of verification results are achieved through the data exchange with the verification agencies.

References
[1] Measurement Development Plan (2013-2020) [S] Beijing: China Zhijian Publishing House, 2013;
[2] He Lili, Bai Hongtao, Research on Aspect mining using clustering analysis; Computer Integrated Manufacturing Systems--cIMS. 2006, (01).
[3] JJF 1051-2009, Designation for Working Measuring Instrument and its Classification Code Technical Specification [S], China Measurement Publishing House, 2009.
[4] Chang Hu, Yue Yang, Juanli Hu, Linying Guo Design and realization of the necessary measuring apparatus for the enterprise receiving the certification, recognition, production license, and the system of registering on line and monitoring dynamically (EBM2010).