

Retraction

Retracted: Quality Data Collection and Quality Monitoring of Smart Electric Energy Meter Based on Acceleration Sensor

Journal of Sensors

Received 22 August 2023; Accepted 22 August 2023; Published 23 August 2023

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

- [1] G. Shen, S. Ye, S. Shen, Y. Xu, and H. Shang, "Quality Data Collection and Quality Monitoring of Smart Electric Energy Meter Based on Acceleration Sensor," *Journal of Sensors*, vol. 2022, Article ID 7583712, 10 pages, 2022.

Research Article

Quality Data Collection and Quality Monitoring of Smart Electric Energy Meter Based on Acceleration Sensor

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Received 11 March 2022; Revised 20 May 2022; Accepted 27 May 2022; Published 14 June 2022

Academic Editor: Pradeep Kumar Singh

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In order to solve the problem of frequent switching and tripping of intelligent power meter and ineffective power failure, a quality data collection and quality monitoring based on acceleration sensor is proposed. Firstly, this paper briefly describes the objects and methods of quality data acquisition and quality monitoring of intelligent watt hour meter. At the same time, based on the analysis of the requirements of quality data acquisition and quality monitoring of intelligent watt hour meter and based on B/S architecture, the quality data acquisition and quality monitoring framework of intelligent watt hour meter is designed. Finally, an intelligent power meter quality monitoring interface with friendly interactive and real-time display acceleration sensor is built using SVG and JavaScript technology. The results show that the collection and monitoring data based on acceleration sensor, three batches of three-phase 0.2 intelligent electric energy meters, meet the operation requirements. Among them, the batch failure rate and classification failure rate in the operation of the third batch are low, and the sampling qualified rate is high, which is an excellent level. The intelligent power meter quality data collection and monitoring system of acceleration sensor can also meet the requirements of full life cycle monitoring of intelligent energy meter quality. It provides a new method for the data acquisition of intelligent electric energy meter and hopes to provide some references for the timely discovery and solution of the quality problems of intelligent electric energy meter in the future.

1. Introduction

Smart electric energy meter is a measurement technology based on modern computer technology and communication technology. The working principle of the smart energy meter: first, the user's voltage and current signals are continuously sampled through the metering chip and A/D converter, and then, the obtained sampled signals are sent to a dedicated integrated circuit for voltage and current signal processing and analysis and converted into electrical signals. The pulse signal proportional to the energy is output to the single-chip microcomputer, and finally through the control and processing of the single-chip microcomputer, the pulse signal is expressed as electric energy and displayed on the display. At present, the construction of intelligent distribution network is carried out on a large scale. As one of the

basic equipment for data acquisition of intelligent distribution network, intelligent watt hour meter has entered the stage of comprehensive construction [1]. In 2020, the total bidding volume of smart meters of the State Grid reached 52.056 million, involving an amount of 11.07 billion yuan. Most cities have achieved full coverage of smart meters. In the process of expanding the application scope of intelligent electric energy meter, the quality problems of intelligent electric energy meter continue to appear, such as clock failure and incomplete display of display screen. The traditional quality data acquisition method of intelligent electric energy meter has been unable to meet the quality monitoring requirements of intelligent electric energy meter. There are problems such as lagging transmission of quality monitoring information and lack of fault prevention and trend analysis in operation stage [2]. Therefore, it is of great significance

to explore the system design scheme of intelligent watt hour meter quality data acquisition and quality monitoring from the perspective of improving the timeliness of intelligent watt hour meter quality data acquisition and the reliability of quality monitoring. Smart electric energy meter is an intelligent terminal of smart grid, which has intelligent functions such as basic power consumption measurement, multi-directional and multirate measurement, power consumption information storage, two-way data communication, user end control, and antielectricity theft [3]. The smart electric energy meter is worthy of the upgraded product in the new era. Compared with the ordinary electric energy meter, it has many “martial arts.” It has the functions of more accurate measurement, memorized power, and remote transmission of information. The differences between smart energy meters and ordinary energy meters are as follows. (1) Smart energy meters have added new functions such as metering information management, electricity consumption information management, electricity billing, and electricity consumption monitoring. Electricity customers provide accurate and timely electricity bill calculation and prepayment functions. (2) The future power grid may change the existing power transmission method. Users can not only consume power from the power grid but also rely on self-built windmills, solar panels, and other power generation devices to supply power to the power grid, and smart energy meters have advanced two-way metering. It supports the utilization of distributed energy. In addition to recording the amount of electricity entering the user, it can also record the amount of electricity the user provides to the grid.

Intelligent electric energy meter based on acceleration sensor is mainly composed of electronic components. During its operation, it can collect the user’s power supply voltage and current data in real time. The sampling voltage and current signals are processed by the special electric energy meter integrated circuit and converted into pulse output proportional to the electric energy. Finally, it is processed and controlled by a single-chip computer and displayed as power consumption before output. Quality data refers to the characteristic value of a quality index [4]. In a broad sense, quality data includes production batch, quality cost loss, invalid operation time, inventory backlog, and other data reflecting the quality of multiple work, which can be improved through lean quality management. In a narrow sense, quality data refers to the data related to product quality, such as qualification rate, number of defective products, repair rate, and straight through rate. It has prominent volatility and can be collected through simple random sampling and full inspection [5]. Kinigstein and others designed the data acquisition scheme of electric energy meter based on the combination of power line carrier and wireless communication technology [6]. Carri and others proposed a power line carrier system based on channel cognition, which can automatically recognize and find the best frequency band as the system working frequency band, so as to ensure the reliability of the system [7]. Cristóbal and others proposed a forward error correction power line carrier modulation scheme based on OFDM, which improved the interference and impulse noise problems of high-speed narrowband data

transmission [8]. Wang and others designed an intelligent meter reader circuit based on infrared communication to increase the communication distance of infrared data acquisition [9]. Jurgielewicz and others introduced laser aiming and infrared aggregation technology into the infrared communication of electric meter, which improved the efficiency of data acquisition [10]. The above methods are improved on the basis of the existing communication methods and do not fundamentally solve the problems of low data acquisition efficiency and unable to communicate in case of power failure.

2. Research Methods

2.1. Objects and Methods of Quality Data Acquisition and Quality Monitoring of Intelligent Watt Hour Meter

2.1.1. Quality Data Acquisition and Quality Monitoring Objects. In the data department, data quality problems are often found passively, so the problem of data quality is a problem that most corporate data departments have to face. The goal of data quality verification is to monitor the correctness, consistency, and timeliness of data from producers, processing stages, and consumers in a data pipeline. Data quality needs to be verified. When serious data pollution and other events occur, alarms and data processing links need to be blocked to minimize problems caused by upstream and downstream data quality. According to the quality data acquisition requirements of intelligent electric energy meters, we can learn from the relevant requirements of GB/t32904-2016, build the quality data acquisition model, select appropriate measurement methods (fuzzy comprehensive evaluation method, expert consultation method, priority method, analytic hierarchy process, etc.), and complete the quality data collection, calculation, and statistics of intelligent electric energy meters. Considering the special nature of industrial operation of intelligent watt hour meter, the main quality characteristics can be set as functionality and reliability [10]. The former includes the conventional function items of intelligent electric energy meter specified in Q/GDM 1354-2013, such as time period, electric energy measurement, clock, deposit transfer on settlement day, zero clearing, and demand measurement. The latter mainly covers the in-depth test items of functional requirements specified in Q/GDM 1354-2013, which is closely related to fault tolerance defects, software convenience, limits, and other factors, such as full rate switching measurement, clock carry boundary timing, limit load measurement, settlement day fault tolerance, baud rate boundary test, time mutation freezing test, limit load power on and off test, and stored data limit test. In addition, it is also necessary to consider the quality requirements of intelligent watt hour meters in a specific case (there are no provisions on the functional specifications and detection standards of watt hour meters), such as multicommutation detection, high-power radio interference test, load ripple, and signal interference.

2.1.2. Quality Data Acquisition and Quality Monitoring Methods. First, the common-mode output voltage of RS-485 is between -7 V and 12 V, and the minimum input

impedance is 12 k Ω , while the output voltage range of RS-422 is only -7 V to 7 V, and the minimum input impedance is only 4 k Ω . Therefore, RS-485 is compatible with all RS-422 electrical specifications. That is to say, the RS-485 adapter can be used in the RS-422 network, and the compatibility is also very good, but in turn, the RS-422 adapter cannot be used in the RS-485 network. After the quality data acquisition object is determined, the analytic hierarchy process can be selected to carry out the quality data acquisition layering of intelligent electric energy meter, clarify the acquisition objects of each layer, compare and judge different acquisition objects, and quantify the impact of different acquisition objects on the overall quality of intelligent electric energy meter, so as to provide support for comprehensive decision-making [11]. For specific quantitative analysis, the following formula can be introduced by referring to the contents of GB/t129831.3 on measurement methods and calculation of measured values:

$$X = 1 - \frac{A}{B}. \quad (1)$$

In (1), X is the quality data acquisition index of intelligent electric energy meter, and the value range is [0.0,1.0]. X approaches 1, indicating that the more comprehensive the quality data acquisition of intelligent electric energy meter is; A, B represents the collected reliability/function item quantity that does not meet the functional requirements of the smart watt hour meter and the reliability/function item quantity of the smart watt hour meter that meets the requirements in the requirements. After collecting the data, the characteristics of the intelligent watt hour meter can be weighted and summed to obtain the final value of the quality of the intelligent watt hour meter, namely,

$$V = \sum V_i \cdot W_i. \quad (2)$$

In (2), V is the final collected value of quality data of intelligent electric energy meter; V_i and W_i are the measured value of quality characteristics and the corresponding weight of quality characteristics, respectively, and i is the quality characteristic identification of intelligent electric energy meter, with the value of 1, 2, 3.

2.2. Requirements for Quality Data Acquisition and Quality Monitoring of Intelligent Watt Hour Meter

2.2.1. Performance Requirements.

The quality data acquisition and quality monitoring of intelligent electric energy meter shall meet the requirements of standardization, ease of use, and scalability. The standard requirement refers to that the whole process of quality data acquisition of intelligent electric energy meter shall meet the requirements of DL/t448-2000 on the accuracy and reliability of electric energy metering device. The demand for ease of use specifically refers to that the quality data acquisition and quality supervision system of intelligent electric energy meter shall facilitate the operator's high-speed and fast operation. Scalability requirements refer to that the quality data acquisition

and quality supervision system of intelligent watt hour meter can follow the changing needs of the structure of intelligent watt hour meter and add new functional modules to solve new problems.

(1) *Functional Requirements.* During the operation of the intelligent watt hour meter quality data acquisition and quality monitoring system, the functions of system management and basic data management are essential. In addition, it also needs to have the functions of data collector/concentrator management, watt hour meter management, CPU card management, plan management, comprehensive query, and so on. The system management function shall include authority management, unit management, data management, and other functions. This is mainly due to the wide application scope and large number of users of intelligent electric energy meter. According to the user category, authority management module can be added on the basis of unit management and data management to meet the needs of flexible collection and management of quality data of intelligent electric energy meter.

According to the maintenance data of intelligent electric energy performance, basic data management should include accuracy level maintenance, technical basis maintenance, type maintenance, plan setting, test item maintenance, voltage/current maintenance, concentrator/collector test item maintenance, detection equipment maintenance, and other functions. The above functions shall cover the whole process of basic data detection and data statistics of intelligent watt hour meter.

As a module that cannot be or is missing in the quality monitoring of intelligent electric energy meter, the management of data collector/concentrator shall include functions such as data acquisition, query, and analysis [12].

As the core of the whole quality data acquisition and quality monitoring system, watt hour meter management shall include basic information input, fixed sample detection management, flight sampling management, sampling acceptance and information input after arrival, operation quality monitoring, full inspection and acceptance monitoring, operation table sampling monitoring, and other functions. Among them, basic information input is the basis of quality data application. It needs to be input in time and comprehensively, and the input information shall be tested regularly. After it is qualified, it shall be transferred to the flight sampling management and sampling acceptance management module after arrival. During the operation of intelligent watt hour meters, suspected faulty watt hour meters can also be reverified and replaced to form a closed-loop quality supervision and control system.

CPU card management needs to have functions such as function card query, power purchase card issuance, and power purchase card query, so as to meet the needs of operators to understand the use of power purchase cards (time, source, and batch) in a short time and avoid the disadvantages of manual paper special personnel recording. Plan management shall include plan query, supply plan setting of the owner, and other functions. The former is the premise

of the operation of each link of the plan setting, which can meet the requirements of accurate query of intelligent watt hour meter. The latter is oriented to the quality monitoring link of intelligent watt hour meter and sets the fixed sample detection plan in combination with the basic data [13].

Comprehensive query is the most concerned content of intelligent watt hour meter quality supervisors, which should include operation fault statistics, supplier service questionnaire, quality monitoring report, sampling acceptance quality monitoring report, comprehensive input of basic information, comprehensive query of fixed sample monitoring, weekly report statistics, presupply quality monitoring report, operation fault statistics, and other functions.

2.3. Design of the Quality Data Acquisition and Quality Monitoring Scheme of the Acceleration Sensor

2.3.1. Overall Structure. An accelerometer is a sensor capable of measuring acceleration. It is usually composed of mass blocks, dampers, elastic elements, sensitive elements, and adaptive circuits. During the acceleration process of the sensor, the acceleration value is obtained by using Newton's second law by measuring the inertial force on the mass block. Common acceleration sensors include capacitive, inductive, strain, piezoresistive, and piezoelectric. Accelerometer is a sensor that can sense acceleration and convert it into a usable output signal. It has the advantages of accurate measurement, stable performance, high reliability, and flexible use. It is widely used in many fields. In order to facilitate Internet users and internal network users to send business requests through the client browser, the three-tier architecture of B/S structure can be adopted, as shown in Figure 1.

As shown in Figure 1, the data persistence layer mainly accesses the database according to the book design method and realizes information interaction with the database. The business logic layer can realize the formulation of various business rules, complete the data exchange between multiple levels, and carry out the logical processing of multiple business rules. The presentation layer is a web interface, which provides operation services for users. The whole framework development course selects Java technology, uses the system with good portability, and carries out multiple transplantation without change order of source code, so as to realize multithreaded operation and multitask parallelism.

When the system framework is deployed, it can be directly connected to the power WAN, allowing users in the power WAN to directly use the existing network system for system access. For areas not connected to the WAN, a set of subsystems with the same functions as the main system will be deployed on the PC, allowing the operator to import the subsystem data into the main system to realize seamless data docking [14].

2.3.2. Hardware Design. In order to make up for the low accuracy and efficiency of the intelligent power meter quality of the acceleration sensor, the quality consistency monitoring module of main components of PCB board of intelligent electric energy meter can be constructed in combination with the actual demand of sample comparison of intelligent

electric energy meter and by referring to the three-axis linkage control automatic camera motion mechanism of industrial camera. From the aspects of image preprocessing, image matching, character recognition, and projection distortion correction, the automatic monitoring of the consistency of hardware PCB board, appearance type, and software communication planning of multimodel intelligent watt hour meter is carried out. During the construction of functional modules, the motion unit (2), controller, computer, detection bit, and camera unit (2) can be reasonably matched.

(1) *Automatic Control Technology, Servo Motor, and Fixed Industrial Camera.* Considering that the appearance type also changes greatly when the model of intelligent electric energy meter changes, on the basis of ensuring the difference of power on detection bits of single-phase intelligent electric energy meter, three-phase three-wire intelligent electric energy meter and three-phase four wire intelligent electric energy meter, the collaborative setting of hardware PCB quality monitoring bits of single-phase intelligent electric energy meter and hardware PCB quality monitoring bits of three-phase intelligent electric energy meter is carried out; that is, using automatic control technology and PLC to accurately control the motion unit, promote the operation of the servo motor of the motion unit, and provide driving force for high-resolution industrial camera positioning and photography. At the same time, the LED intelligent light source is controlled to operate, the industrial camera is fixed by the camera unit, and the image is collected from the end of the intelligent electric energy meter and the front of the hardware PCB board. Then, with the support of image processing technology, carry out LED intelligent light source adjustment, hardware PCB front image pixel comparison and intelligent recognition, and complete the quality data collection such as the appearance type of intelligent watt hour meter and the consistency of hardware PCB.

(2) *Three-Axis Linkage Control Motion Mechanism, CMOS Black-and-White Industrial Camera.* For the reliability data such as clock carry boundary timing, limit load measurement, and settlement day fault tolerance of intelligent electric energy meter, the camera unit can be installed on the three-axis linkage control motion mechanism. The carrier of the camera unit is a 5 m pixel CMOS black-and-white industrial camera. In order to ensure the accuracy of quality data collection, three groups of linear modules and sliding rails can be set when the three-axis linkage control motion mechanism is built. The x -axis and y -axis in the horizontal direction drive the camera unit to move along the horizontal direction so that the camera unit can collect different position data of the intelligent electric energy meter. A linear slide guide is added on both sides of the butt joint to give a limited value of horizontal rotation freedom of the propulsion mechanism to ensure the reliability and data collection accuracy of the intelligent electric energy meter. The z -axis in the vertical direction assists the camera unit to complete automatic focusing, which provides a basis for the quality data collection of multiple models of intelligent watt hour

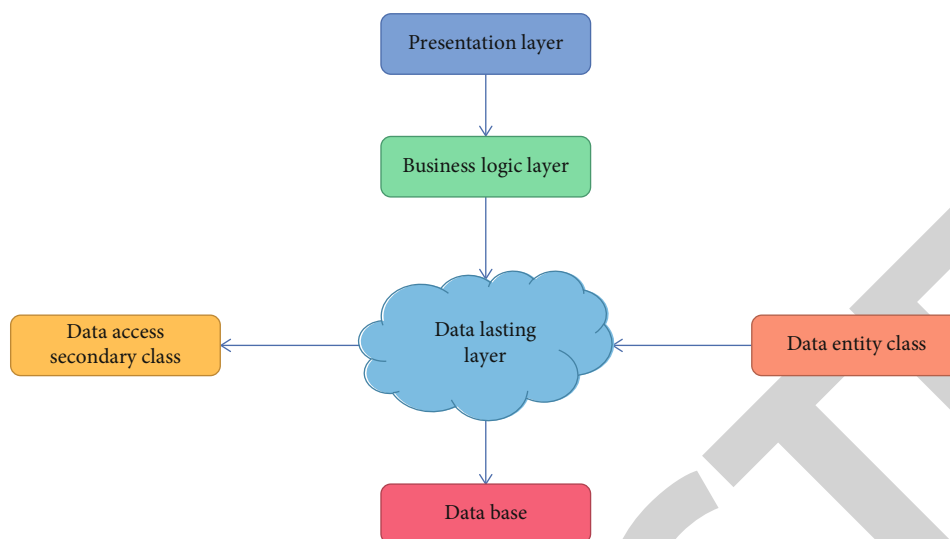


FIGURE 1: Quality data collection and quality monitoring architecture of intelligent watt hour meter.

meters. Generally, the formation of x -axis, y -axis, and z -axis can be set as 60 cm, 30 cm, and 30 cm, respectively, and the repeated positioning accuracy is 0.001 mm. The maximum speed of high-speed motor equipped on the motion control axis is 5000 revolutions per minute, so as to improve the reliability and data collection efficiency of intelligent electric energy meter.

(3) *Feed Servo Motor*. Intelligent power meter communication regulation quality data for acceleration sensors, it is necessary to feed the servo motor to provide the driving force for the standard terminal base corresponding to the power on detection position. Combined with the range control output voltage of the intelligent electric energy meter, the linear module and large torque motor are established to complete the automatic and reliable power supply of the data acquisition module of the intelligent electric energy meter. At the same time, using the communication protocol consistency detection program on the computer, with the support of DL/t645-2007, the method of reading and writing data is introduced through the computer RS232 interface and intelligent RS485 interface to complete the content detection of communication protocol and the interactive information conversion between intelligent watt hour meter and computer.

2.3.3. Core Functions

(1) *System Management and Basic Data Management*. The system management module includes three parts: role management, user management, and unit management. Its users are system administrators, and the data items and processing rules are basically the same. The role name is required. Other processing rules are click “add” to enter the name and remarks; click the “modify” button to modify the name and remarks; click the “delete” button to delete the created name and the corresponding menu.

The basic data management module includes technical basis maintenance, monitoring project maintenance, supplier maintenance, intelligent watt hour meter type maintenance, and other parts [15, 16]. All items are optional except the name is required. Other processing rules are click add to create a new supplier or accuracy grade and table type; click the “delete” button to delete a supplier or accuracy grade and table type; click the “modify” button to modify a supplier or accuracy grade and table type.

(2) *Plan Management*. Plan management mainly includes two parts: plan query and plan setting. It involves plan customization, plan type, flight sampling plan, operation table sampling plan, fixed sample detection technology, and setting sampling quantity. Through the design function, it can meet the requirements of modifying the selected plan information, querying the plan function and name, and querying the execution process of the detection phase.

(3) *Concentrator/Collector Management*. Concentrator/collector management is an important part of intelligent watt hour meter quality data acquisition and quality monitoring, including flight sampling inspection and centralized test. It is necessary to input each test data into the system for query, including starting collection, entering database, and comprehensive query. The function can be designed as enter/modify/delete a concentrator or collector information. At the same time, through the conditions of unit and test type, carry out rapid statistics, analysis, and query of data and display it in spreadsheet and graphics [17]. It should be noted that for the collector, two modes can be set, one of which is the direct acquisition mode. By connecting the terminal application and the edge acquisition terminal, the terminal sends instructions to the acquisition terminal and equipment level by level to quickly obtain the feedback data. The other mode is the equipment active reporting mode; that is, establish a connection between the terminal

application and the edge acquisition terminal, the intelligent watt hour meter actively transmits the quality data to the edge acquisition terminal, and the edge acquisition terminal feeds back the data to the terminal application in real time.

(4) *CPU Card Management*. CPU card management is mainly based on the operator's quick understanding of the requirements of CPU card and completes the management from the aspects of information level related to power purchase card, unified management of power purchase card, and use of power purchase card. In the whole process of function exertion, you can add/delete/modify a record of power purchase card issuance information to complete the record, which is convenient for subsequent operators to carry out power purchase card information of different units and different time periods through search conditions.

(5) *Comprehensive Query Statistics*. Comprehensive query includes operation quality query, operation random inspection statistical report, post arrival acceptance query, and other modules. The design functions can be input name/model/batch, quickly query quality fault and historical fault, and export spreadsheet.

(6) *Intelligent Power Meter Management of Accelerometer Sensors*. Intelligent power meter management of the accelerometer sensor includes basic information input, full inspection and acceptance management, operation table sampling management, and basic information input. In the overall function design, the tree structure shall be used to display the basic information of the intelligent watt hour meter, and when clicking any node, all the information of the intelligent watt hour meter under the node shall be displayed. At this time, you can add/delete/modify a new smart watt hour meter by clicking the add/delete/modify button. In addition, some quality problems will inevitably occur during the operation of intelligent watt hour meters. It is necessary to add a fault entry link to complete the entry from two aspects: single meter fault entry and batch fault entry. The specific process is shown in Figure 2.

2.3.4. Database Design. In the database design, based on the redundancy control requirements of various types of data, implement the principles of integrity and consistency, comprehensively consider the free exchange requirements of various data tables and E-R diagrams, preliminarily determine the attributes of each entity and define the proportional relationship between entities, and finally come to the overall list of intelligent power meter quality data acquisition and monitoring database as follows (Table 1).

The fields included in the above overall table list are ID (required for primary key), address (optional for other fields), number (optional for other fields), node ID (optional for other fields), and remarks (optional for other fields). Taking the accuracy level maintenance table as an example, it mainly includes one required primary key item—level ID—and two optional items—level name, remarks, and note. The details are as follows (Table 2).

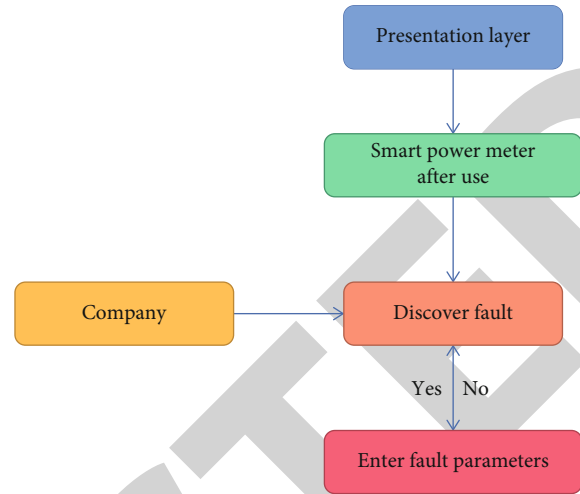


FIGURE 2: Quality fault input process of intelligent watt hour meter.

2.3.5. Interactive Interface. The interactive interface of the intelligent power meter quality data collection and monitoring system of the acceleration sensor shall meet the requirements of graphical intuitive visualization and data image statistics so that users can directly operate the graphic elements in the system interface to complete the adjustment and setting of intelligent watt hour meter quality data monitoring parameters, automatic generation of work orders, information search, and query tasks [18]. At the same time, the graphic system refreshes the data in real time according to the changes of the quality index parameters of the intelligent electric energy meter and carries out the quality early warning and alarm of the intelligent electric energy meter in real time in combination with the geographic information. Based on this, when designing the interactive interface of intelligent watt hour meter quality data acquisition and quality monitoring system, the root element < sug >, group < g >, entity < symbol >, reference element < defs >, and basic shape elements < circle >, < line >, < polygon > can be defined with the help of XML based open vector graphics format SVG. At the same time, considering that there are several graphics with the same type, the same structure and different direction and position in the graphical display interface of the intelligent power meter quality data acquisition and quality monitoring system, the DOM sink tree interface function can be used to identify SVG documents, and the SVG graphics interaction can be completed through JavaScript. Or through the < use > element, combined with the ID attribute, directly use the element < symbol > to define the graphic template. The details are as follows.

At this time, when the smart watt hour meter graphic element needs to be applied in the interactive interface of the smart watt hour meter quality data acquisition and monitoring system, just enter < use: Xlink:href="#zhiningdian-nengbiao" >, and the corresponding graphic element can be applied. Or click the intelligent watt hour meter batch information option in the operation information column to trigger the time of intelligent watt hour meter quality data acquisition or quality monitoring to realize batch information interaction. At the same time, when the intelligent

TABLE 1: Overall list of intelligent power meter quality data acquisition and monitoring database (partial).

| Table name | Explain |
|--------------------|------------------------------------------|
| DB_RESTON | Technical basis maintenance |
| CM_REGISTRATION | Concentrator/collector information entry |
| DB_TYPE_PROJECT | Table of equipment type and test items |
| EF_ACCEPTANCE | Acceptance form after arrival |
| EF_OWNERSORGDETAIL | Detailed supply list of the owner |
| DB_TYPE_RESTON | Technical table of equipment type |
| BD_ACCURACYRANK | Accuracy level maintenance table |

TABLE 2: Maintenance of accuracy level.

| Field name | Field description | Is it empty | Length | Data type |
|-------------|-------------------|-------------|--------|--------------|
| Level ID | Primary key | No | | INT |
| Grade name | Other | Yes | 20 | VARCHAR (20) |
| Remark note | Other | Yes | 20 | VARCHAR (20) |

```

<symbol id = "zhinengdiannengbiao" xingming = "zhinengdiannengbiao">
<g>
<juxing x = "218"y = "153"kuandu = "131"gaodu = "218"chongman="#D9D9D9"/>
...
<tuoyuan cx = "333.5"cy = "292"rx = "4.5"ry = "13"chongman="#F5F3F3"/>
</g>
</symbol>

```

CODE 1

```

AS
BEGIN
DECLARE @md5 varchar(34)
SET @md5 = sys.fn_VarBinToHexStr(hashbytes('MD5', @src));
RETURN SUBSTRING(@md5,11,16) -16位
RETURN SUBSTRING(@md5,3,32) -32位
END
Go

```

CODE 2

electric energy meter has a serious fault problem, it can refresh the fault state in real time and display the alarm graphics and specific information through the combination of SVG and Ajax [19, 20]. The whole operation process is as follows: in the first step, the client sends a request to the server and creates a refresh object to request the server address information. In the second step, the server executes PLSQL language to exchange data with the database of intelligent power meter quality data acquisition and quality monitoring system to obtain data in XML format. The third step is to return to the client and analyze and process the client based on Ajax asynchronous communication. Step 4: call the JavaScript script, write new data in the SVG file, and

refresh the fault information collected by the intelligent watt hour meter quality data collection and quality monitoring system in real time. The client carries out data interaction with the server regularly, completes server data analysis and corresponding SVG graphics revision, and realizes real-time alarm in the form of SVG animation.

2.3.6. Safety Mechanism. To ensure the safe operation of the intelligent power meter quality data collection and quality monitoring system of the acceleration sensor, in addition to timely starting the real-time backup of database data and appropriate encryption mode, it is also necessary to add a security design module on the database system. That

TABLE 3: Summary of quality data of intelligent power meter.

| Quality data acquisition stage | Collection index | First batch | Second batch | Third batch |
|--------------------------------|---------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------------------------------------|
| Product reliability | Whole meter failure rate (10 years) | Qualified | Qualified | Qualified |
| | Component failure rate (10 years) | Qualified | Qualified | Qualified |
| Factory inspection | Estimated reliability of products (10 years) | 97% | 96% | 97% |
| | Deviation between factory basic error and average error | 0.11 | 0.09 | 0.04 |
| Manufacture supervision | Appearance and logo | Qualified | Qualified | Qualified |
| | Component consistency | Agreement | Agreement | Agreement |
| Quality before arrival | Process integrity | Agreement | Agreement | Agreement |
| | Sample sampling full performance | Partial incompleteness, timely modification | Complete | Complete |
| After arrival | First pass rate of test before arrival | 99.77% | 99.66% | 99.99% |
| | Full inspection and acceptance | Qualified | Qualified | Individual unqualified, timely rectification |
| Operation table | Batch failure rate | The qualified rate is 97.99%, and the number of faults of the same product is more than 2. It has been returned to the factory for timely treatment. | | |
| | Sampling inspection qualification rate | 0% | 0% | 0% |
| | Classification failure rate | 99.82% | 99.38% | 99.90% |
| | Batch failure rate | 0.93% | 1.15% | 0.66% |
| | | 2.05% | 2.11% | 0.66% |

is, starting with the prevention and control of users directly deleting or adding or modifying the quality data in the database, the encryption algorithm MD5 is used for data encryption. Users can modify the quality data in the database only by logging in to the application software and accessing the database through their account. That is, first create a table with S_taff as the table name and S_Name as the name field, and then, create an MD5 encryption function, namely, create function [dbo] [MD5](@src varchar (255)) RETURNS varchar (255).

After the MD5 encryption function is created, enter “select dbo.md5 (‘123’)” and the query result is (no column name). At this time, call the data table and the result is s_Name.

On the basis of ensuring the safe operation of the intelligent electric energy meter database, the trusted authentication method can be introduced into the data interface access link. According to the application scenario and data transmission mode, the corresponding trusted authentication method can be run instead of the traditional data password encryption method, and the password system can be constructed in the regional and regional quality data transmission links to prevent illegal users from stealing key information. Ensure the safety of data reading and writing in the quality data acquisition stage of intelligent watt hour meter. Take the trusted quick signature verification as an example. AlipaySignature.rsaCheckV1 can be used on the normal interface, while sign_type does not participate in the signature, and the parameters are reserved to participate in the signature verification.

IEEE P1159.3/D9 has developed a standard data format for power quality data transmission, namely, the PQDIF international standard. PQDIF adopts a flat file structure, which consists of a set of related records, and each record consists of a set of elements. These elements define the record content from the physical and logical layers. As a standard specification, PQDIF is conducive to the standardized development of the power quality monitoring system. Therefore, the power quality monitoring system also adopts the PQDIF standard as the data transmission specification. The data conversion module is defined in accordance with the PQDIF structure and extracts the power quality data obtained from the data management module, encapsulated into standard data format information. The power quality monitoring system regards the PQDIF file as a standard data source, reads the data contained in the file, and stores it in the database.

3. Result Discussion

3.1. Quality Data Collection and Quality Monitoring Operation Effect of Acceleration Sensor

3.1.1. *Operating Environment.* The operation environment of the intelligent electric energy meter quality data acquisition and quality monitoring system is the PC computer with network card and IE browser. The server needs to meet the core dual i7 3.4GHz, and the hard disk memory needs to reach 2T. The server-side software shall include the Windows Server 2010 operating system, the database shall be

SQL Server 2010, the browser shall be more than ie10.0, and the network protocol shall be TCP/IP protocol.

3.1.2. *Operation Results.* Take the object of three batches of intelligent electric energy meters based on acceleration sensors produced by a certain manufacturer; the quality data acquisition and quality monitoring system of intelligent watt hour meters designed in the early stage is used to collect and process various quality parameters. The relevant data of three batches of three-phase 0.2 intelligent watt hour meters are as follows (Table 3).

The results of collection and monitoring of intelligent power meter quality data based on acceleration sensor are known; it can be seen that the three batches of three-phase 0.2 intelligent electric energy meters meet the operation requirements. Among them, the batch failure rate and classification failure rate in the operation of the third batch are low, and the sampling inspection qualification rate is high, which is an excellent level. The intelligent power meter quality data collection and monitoring system can also meet the requirements of intelligent power meter quality life cycle monitoring.

4. Conclusion

To sum up, at present the traditional acceleration sensor intelligent power meter quality data collection and quality monitoring means have high economic value, large quantity, multifarious, operation cycle, complex management, scattered defects, data collection and lack of transmission efficiency, precision, and cannot reflect the quality of the whole life cycle monitoring. Therefore, on the basis of analyzing the needs of the intelligent power meter quality data collection and quality monitoring of the acceleration sensor, we can start with the comprehensiveness of the system, design the quality data acquisition and quality monitoring architecture of B/S structure, and allow users to access the quality data of intelligent electric energy meter through power WAN, Internet/VPN of high-voltage hall, manual access to WAP site, etc. At the same time, lightweight certificate, distributed authorized terminal authentication and access, trusted fast signature verification mechanism, and distributed trusted authorization authentication management model technology are applied to build a perfect security mechanism, so as to timely mine, locate, and eradicate relevant factors when encountering risk factors, to support the quality operation of the intelligent energy meter of the acceleration sensor. Experiments show that the data acquisition system and production process intelligent monitoring technology used in this study are very practical and will be an effective way to improve the image of power companies and the comprehensive strength of power market competition.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no competing interests.

Acknowledgments

The study was supported by the Science and Technology Project of State Grid Corporation of China (Research and Application of Quality Analysis and Evaluation Technology of Intelligent Watt Hour Meter Based on Whole Chain Data, Project No. 5600-201955458A-0-0-00).

References

- [1] M. Liu, D. Liu, G. Sun, Y. Zhao, and D. Xu, "Deep learning detection of inaccurate smart electricity meters: a case study," *IEEE Industrial Electronics Magazine*, vol. 14, no. 4, pp. 79–90, 2020.
- [2] G. Li, F. Liu, A. Sharma et al., "Research on the natural language recognition method based on cluster analysis using neural network," *Mathematical Problems in Engineering*, vol. 2021, 13 pages, 2021.
- [3] R. G. Rodríguez, J. J. Mares, and G. Christian, "Computational intelligent approaches for non-technical losses management of electricity," *Energies*, vol. 13, no. 9, pp. 2393–2396, 2020.
- [4] A. Gülcü and S. Alikan, "Clustering electricity market participants via firm models," *Intelligent Decision Technologies*, vol. 14, no. 4, pp. 1–12, 2020.
- [5] J. Pyra and M. Kaczyński, "Issues of data acquisition and interpretation of paraseismic measuring signals triggered by the detonation of explosive charges," *Sensors*, vol. 21, no. 4, pp. 1290–1295, 2021.
- [6] E. D. Kinigstein, G. Jennings, C. A. Kurtz, A. M. March, and X. Zhang, "X-ray multi-probe data acquisition: a novel technique for laser pump x-ray transient absorption spectroscopy," *Review of Scientific Instruments*, vol. 92, no. 8, pp. 085109–085111, 2021.
- [7] A. Carri, A. Valletta, E. Cavalca, R. Savi, and A. Segalini, "Advantages of iot-based geotechnical monitoring systems integrating automatic procedures for data acquisition and elaboration," *Sensors*, vol. 21, no. 6, pp. 2249–2253, 2021.
- [8] J. Cristóbal, P. Graham, A. Prakash, M. Buchhorn, and M. Bertram, "Airborne hyperspectral data acquisition and processing in the arctic: a pilot study using the hypspec imaging spectrometer for wetland mapping," *Remote Sensing*, vol. 13, no. 6, pp. 1178–1184, 2021.
- [9] M. Wang and Y. Wang, "Data acquisition model for online learning activity in distance english teaching based on xapi," *International Journal of Continuing Engineering Education and Life-Long Learning*, vol. 31, no. 1, pp. 1–5, 2021.
- [10] P. Jurgielewicz, T. Fiutowski, E. Kublik, A. Skoczeń, and B. Mindur, "Modular data acquisition system for recording activity and electrical stimulation of brain tissue using dedicated electronics," *Sensors*, vol. 21, no. 13, pp. 4423–4426, 2021.
- [11] R. Xu, D. Long, J. Liu, W. Yu, and L. Xu, "Intelligent assistant decision-making method for power enterprise customer service based on iot data acquisition," *Mobile Information Systems*, vol. 2021, Article ID 7100610, 10 pages, 2021.
- [12] M. Raj, P. Manimegalai, P. Ajay, and J. Amose, "Lipid data acquisition for devices treatment of coronary diseases health stuff on the Internet of medical things," *Journal of Physics: Conference Series*, vol. 1937, article 012038, 2021.
- [13] F. V. Assche, S. Vanheule, L. V. Hoorebeke, and M. N. Boone, "The spectral X-ray imaging data acquisition (spexidaq) framework," *Sensors*, vol. 21, no. 2, pp. 563–568, 2021.
- [14] L. Xin, L. Jianqi, C. Jiayao, and Z. Fangchuan, "Degradation of benzene, toluene, and xylene with high gaseous hourly space velocity by double dielectric barrier discharge combined with Mn3O4/activated carbon fibers," *Journal of Physics D: Applied Physics*, vol. 55, no. 12, article 125206, 2022.
- [15] Y. Cetinceviz, D. Uygun, and Y. Gungor, "An effective speed controller and gprs based data acquisition system design for dc motors," *Review of Scientific Instruments*, vol. 91, no. 3, pp. 035120–035125, 2020.
- [16] A. Geary, "Seismic soundoff," *The Leading Edge*, vol. 39, no. 1, pp. 72–72, 2020.
- [17] F. Santoni, A. D. Angelis, A. Moschitta, and P. Carbone, "A multi-node magnetic positioning system with a distributed data acquisition architecture," *Sensors*, vol. 20, no. 21, pp. 6210–6215, 2020.
- [18] R. Huang, P. Yan, and X. Yang, "Knowledge map visualization of technology hotspots and development trends in China's textile manufacturing industry," *IET Collaborative Intelligent Manufacturing*, vol. 3, no. 3, pp. 243–251, 2021.
- [19] G. Shu, T. Shi, L. Huang, Z. Gao, and S. Huo, "Compressive seismic data acquisition in a desert area of western China: a case study," *The Leading Edge*, vol. 39, no. 5, pp. 340–344, 2020.
- [20] J. Gu, W. Wang, R. Yin, C. V. Truong, and B. P. Ganthia, "Complex circuit simulation and nonlinear characteristics analysis of GaN power switching device," *Nonlinear Engineering*, vol. 10, no. 1, pp. 555–562, 2021.