

# Design of Automatic Management System of Electric Power Marketing Charges and Accounts Based on Robot Process Automation

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**Abstract:** In the automation construction of marketing charge accounts in power supply enterprises, the key is the automation system of electric energy measurement. It covers all levels of measurement points and collection terminals in the whole network, and integrates measurement management, analysis, monitoring and information collection. The traditional electricity charge management of electric power enterprises is the process of manual meter reading, accounting and charging. Meter readers go to each customer every month to read the meter according to the meter reading time and meter reading card, record the number of electric energy meters on the meter reading card, and then copy the data of the meter reading card on the accounting card. Manual meter reading can't meet the current demand. Therefore, this paper will study the automatic management of electric power marketing charges based on RPA (Robot process automation), and build an automatic management system of electric power marketing charges. Through the comparative analysis of experimental data, the experimental results of the response accuracy of different systems show that this system is still more advantageous, and the accuracy of this system is the highest, with an average accuracy of 81.59%. However, the accuracy of reference method and reference method are 62.72% and 46.95% respectively. A perfect charging system based on RPA can not only improve the service level and corporate image of power supply companies, but also improve the management level of power supply companies, thus improving the economic benefits of enterprises.

**Keywords:** Robot process automation; Power marketing; Charge accounting; Automated management system.

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## 1. Introduction

With the marketization and commercialization of the electric power industry in China, power supply enterprises at provincial, municipal and county levels, which have always focused on single safety production, are facing new challenges and opportunities. In the new pattern, the focus of work should be shifted to the measurement of basic data, the exchange of information between various departments, and the analysis of massive data. In the construction of marketing charge accounting automation of power supply enterprises, the key is the electric energy measurement automation system. It covers all levels of measurement points and acquisition terminals of the whole network, and integrates measurement management, analysis, monitoring, information collection and other work. Its function is mainly to provide technical support for market management, pre-purchase of electricity, orderly use of electricity, load control, remote meter reading, settlement of electricity charges and other work of power supply enterprises. At the same time, on this basis, it is extended to applications such as customer energy conservation assessment, power supply and sales statistics, line loss quartering statistics and power supply quality statistics. The traditional electricity charge management of electric power enterprises is the process of manual meter reading, accounting and charging. The meter reading personnel read the meter at each customer every month according to the meter reading time and the meter reading card, record the end of the electricity meter on the meter reading card, and then copy the data of the meter reading card on the account card.

In view of the above situation, this paper will design the automatic management system of electric power marketing

charge accounting based on RPA. As the core business of the electric power system, electric power marketing has improved and sublimated its business structure on the basis of the four-tiered structure proposed by the original State Electric Power Corporation. More business information exchanges and closer collaboration of cross departmental business processes constitute a mesh electric power marketing application. The core of RPA is to "replace people" through automation and intelligent technology for repetitive, low value, no manual decision-making and other fixed process operations, so as to effectively improve work efficiency and reduce errors. The electric power marketing charge management system established through RPA is responsible for the marketing automation of power departments at all levels. The goal is to further improve the automation of the electric power marketing business of power supply enterprises at all levels. As an important part of the electric power marketing management information system, the main function of the electric power real-time charge system is the real-time collection of electricity charges. From the perspective of the market, as an important part of power operation and management, the recovery of electricity charges is actually a direct link to achieve the economic benefits of power enterprises. For power supply enterprises at all levels, the company should also provide convenient services for residents and enterprises to collect electricity charges. The charging system based on RPA can not only improve the service level and corporate image of power supply companies, but also improve the management level of power supply companies, thus improving the economic benefits of enterprises.

## 2. Advantages of robot process automation

### 2.1. The Theory of Robot Process Automation

RPA is a way for virtual robot to replace manual labor, which can not only simulate human beings, but also integrate and embed existing artificial intelligence technologies, such as image recognition, natural language processing and other technologies, to achieve the goal of process automation. The most obvious advantage of RPA is direct cost reduction and efficiency increase. RPA can replace people or auxiliary people to carry out a wide variety of process automation tasks, which can reduce a lot of costs for enterprises. RPA is a business process automation technology based on software robots and artificial intelligence. As long as the rules and processes are designed in advance, RPA can capture and simulate manual operations, click, input, copy, paste and other behaviors, and assist in completing a large number of "work based on fixed rules, with high repeatability and less analysis". More generally speaking, RPA is to use some scripts that can be automatically executed to complete a series of tasks that originally needed to be done manually. Any tool with certain script generation, editing and execution ability can be called "robot" here. RPA robot can realize the interaction between multiple applications and systems, not only limited to the operation of office tools. The more mature and advanced RPA is a robot with self-awareness or intelligent automation, which can perform unconventional tasks, including judgment of unstructured data and intelligent decision analysis. RPA is a typical C/S software system architecture, as shown in Figure 1.

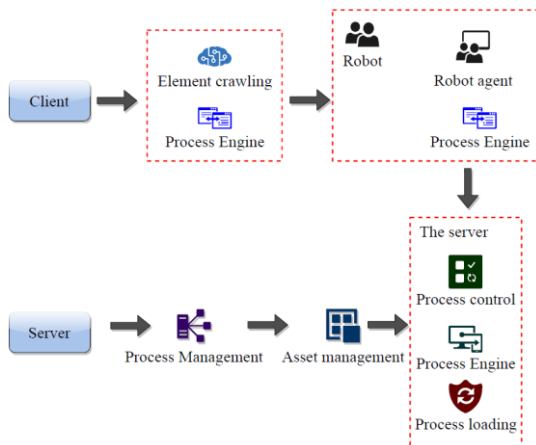


Figure 1. RPA structure diagram

RPA is equivalent to one or any number of "virtual employees". It can quickly inherit the experience accumulated in various business fields. After the instruction is given, it can quickly enter the working state, be tireless, have higher efficiency, and the error rate is close to "0". The simplest working principle of RPA is to record the mouse and keyboard actions of the operator to form an operation script. The script here can be modified, and users can modify the parameters and rules of the script according to their needs, which is tedious and repetitive. It is driven by the main process rules, and does not require too much human judgment, and the work that is frequently processed and repeatedly performed, such as automatic calculation, process approval, etc. RPA technology can improve efficiency while ensuring accuracy. RPA is mainly used in contract downloading and enterprise qualification verification. The common feature of

these two processes is that they have repetitive and similar action tasks and clear structured data, which is more suitable for the implementation of robot automation processes.

### 2.2. Development of Robotic Process Automation

At present, industrial robots have been widely used in various industries, ranging from machinery manufacturing, automobile production, nuclear power facility maintenance, nut and nut production, mask production and candy industry. Since RPA products are put into use for the first time, most companies will choose a supplier. In order to ensure the later operation, they will establish a long-term partnership with the supplier, but at the same time, they will also expose the enterprise's operating data to the other party's monitoring system in real time. Moreover, the product has strong universality and cannot meet the individual needs of enterprises. Continuous training on RPA applications, especially in large and medium-sized enterprises or enterprises that have established financial sharing service centers, should test the system before putting it into use to avoid unnecessary resource waste caused by large business volumes and complex business types. After years of development and generations, RPA has been widely used in various fields from RPA1.0 to RPA4.0 through evolution of multiple times. 1) RPA1.0: Free hands, free migration between structured data applications; 2) RPA2.0: replace hands, intelligent modeling and analysis after full coverage of data types; 3) RPA3.0: Enhance human brain, usher in a new era of machine reasoning and automatic business management.

RPA consists of server, editor and robot. The server is the process robot management platform, which is responsible for the daily management of the client process robot, such as release management, log archiving, monitoring report, remote control, task scheduling, load balancing, etc., to ensure that the process robot works normally. The prerequisite for robots to perform automated processes is to have the necessary basic data. The significance of basic data is to specify the execution scope for the robot and specify the specific object of operation. Therefore, accurate and comprehensive basic data is the premise of RPA. Combined with RPA technology, voice text recognition, intelligent question answering and other technologies, it has realized the automation of the whole process of public transformer power outage, which can effectively replace the grass-roots marketing personnel to achieve power outage operation for public transformer users, and to some extent, it has avoided the impact of uncertain factors such as personnel flow, manual mis operation on the public transformer power outage indicators and work efficiency.

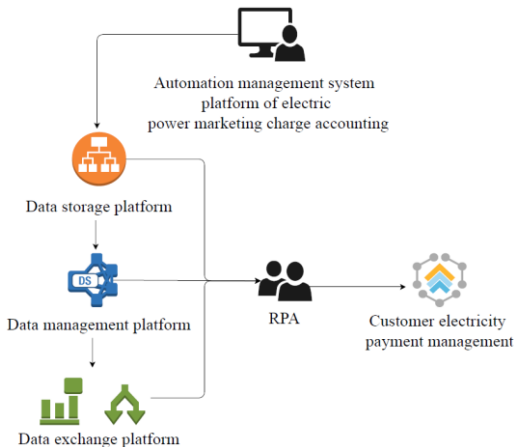
## 3. Application of Automatic Management of Electricity Marketing Charges and Accounts Based on Robot Process Automation

### 3.1. Design of automatic management system for electric power charging accounts

It is the client of robot RPA, which provides work such as process arrangement, monitoring, process scheduling, workflow and resource deployment. In addition to detailed logging and statistical functions, it can also save information

such as process operation cutting maps and operation videos, making robot management easier and more accurate. Based on RPA, the automatic management system of electric power marketing charge accounts is designed. The platform design scheme of "five platforms" mode is adopted, including data storage platform, data management platform, data exchange platform, data work platform and data disaster recovery platform. Specifically, the data storage platform manages, stores and retrieves data. The data management platform is the most critical in the electric power payment management system, which gathers all the business units to be processed, and is responsible for accessing and completing the overall fee payment, electricity calculation, fee collection and payment. The incomplete voltage meter data is collected in the two-rate and one-loss system, and the data call test needs to be operated in the acquisition system. At the same time, there are too many voltage points in the meter, and only one-by-one copy of the meter's household number can be used for data call test, which adds workload to the staff [11].

RPA process can automatically realize the data interaction between systems, and replenish mining at regular time, which improves the efficiency and accuracy of replenish mining. It can be seen from RPA's access user types and voltage levels that the power metering automation system includes four subsystems, namely, low-voltage centralized meter reading system, load management system, power metering telemetry system of power plants and stations, and distribution transformer monitoring and metering system. The low-voltage centralized meter reading system is composed of the main station system and the related power supply, transmission channels, power collection and metering devices installed at the residential power room side and residential users' side, etc., mainly to count the load status of this metering point, and analyze the monthly power uploading and marketing system and distribution transformer of this metering point on this premise. The platform design of automatic management system for electric power charging accounts is shown in Figure 2.



**Figure 2.** Power marketing charge accounting automation management system platform

When the system is applied to electric power marketing and management, it can first support remote centralized meter reading, which will greatly improve the efficiency of meter reading; Secondly, it can realize online monitoring of users' electricity consumption behavior and payment of electricity bills, support real-time operation and processing of abnormal electricity consumption, ensure electricity safety and reduce power supply risks; Finally, the real-time price, time of use

price and outage information of the power market can be sent to users in time to improve the power service quality [12]. When there is harmonic current in the distribution network, the effective value  $I_{\Sigma}$  of non-sinusoidal periodic current is equal to the square root of the square sum of its fundamental component  $I_1$  and the effective value  $I_h = (h = 2, 3, 4, \dots)$  of each harmonic component:

$$I_{\Sigma} = \sqrt{\frac{1}{T} \int_0^T i^2(t) dt} = \sqrt{I_1^2} \quad (1)$$

Therefore, when harmonics exist, the additional loss  $\Delta P_5$  caused by  $I_{\Sigma}$  flowing through the line with resistance  $R$  is:

$$\Delta P_5 = I_{\Sigma}^2 R - I_1^2 R \quad (2)$$

Assume that the active power loss is  $I^2 R_{eqv}$  under ideal conditions; When there is contact resistance, the active power loss is  $I^2 (R_{eqv} + R_c)$ , so the additional loss is:

$$\Delta P_4 = I^2 R_c \quad (3)$$

RPA realizes line loss quartering online management and improves line loss refined management level. Taking the construction of measurement automation system as an opportunity, focusing on technological innovation, the online line loss quartering management module has been built through the business distribution integration platform and relying on the measurement automation system. The login of users and management personnel, query, deletion, addition of charging information, power charging, etc. were tested. Problems in the system were found by simulating real-time detection of thousands of users. The test results were analyzed, as shown in Table 1.

**Table 1.** Average test data of system

Number	Concurrent operand	Average transaction response time	Request response time	Whether it operates normally
SF-01	300	1.52	0.26	Yes
SF-02	300	1.47	0.31	Yes
SF-03	300	1.59	0.29	Yes

However, the indicator data is scattered in different business systems, and the operation of indicator statistics is complex, time-consuming and laborious. RPA technology is adopted to automatically acquire and summarize the index data of multiple systems such as SG186 and consumer acquisition, which reduces the time for staff to frequently switch systems to query data. Under the intelligent construction and management mode of electric power enterprises, RPA applies the metering automation system to the meter reading operation link to achieve accurate screening, real-time audit, efficient accounting, monitoring and maintenance of electric energy data. It can effectively build a closed-loop working mechanism for meter reading, accounting and charging, and strengthen the control of the inspection and circulation accounting link based on the whole process and automation management mode, further improve the management efficiency and data accounting quality of low-voltage meter reading.

### 3.2. Realization of automatic management system of electric power charging accounts

The automatic management system of electric power marketing charge accounts realizes the effective control of electric power metering in stations and electric power transmission in substations, and provides services for electric power supervision and management. Specifically, the test content mainly covers three aspects: overload power consumption, power fault detection and illegal power consumption behavior, and supports the tracking management of power metering and power transmission, ensuring timely identification of abnormal information and fault problems, and improving the level of power metering. It is necessary to establish an internal control management operation mechanism which is guided by risk strategic management, realizes self-control management of business risks, and is supported by internal control information communication management, internal control supervision, evaluation and punishment management. Realize the refined online monitoring of the internal control management information system, ensure the establishment of a sound assessment system, organizational system, internal control enterprise culture and internal control basic environment, ensure a perfect risk refined whole process management, ensure that every step can be effectively implemented, ensure that various business risks can be avoided, and promote the sustainable development of electric power enterprises. This chapter will further verify the automatic management system of electric power marketing charges and accounts. In order to prevent errors or defects in software development, the basic functions of the system are tested at first, and the performance of the system needs to be tested, mainly focusing on the response time and response accuracy of the system. In this paper, the systems in literature and literature will be compared with the system in this paper, and the experimental results are shown in Figure 3- Figure 4.

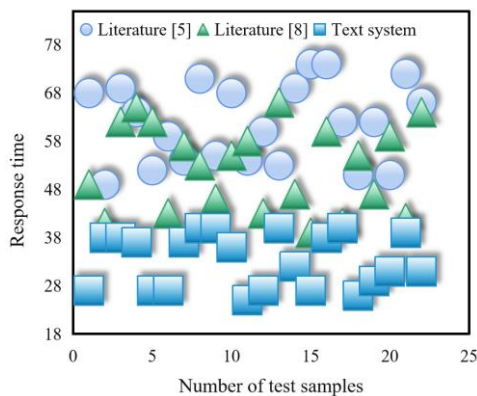


Figure 3. Response time of different systems

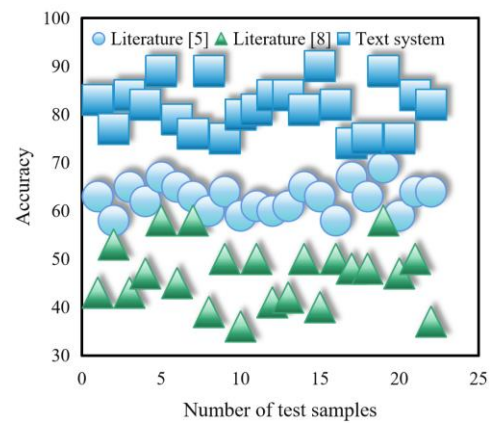


Figure 4. Accuracy of different system responses

It can be found from the data in Figure 3 that the experiment tests the performance of the system and compares the response time of three different systems. The system response time in this paper is the shortest, with an average time of 33.27 seconds, followed by the system in literature, with an average time of 52.45 seconds, while the system in literature takes the longest, with a time of 61.68 seconds. It can be seen from the experimental results of the accuracy rates of different system responses in Figure 3 that the system in this paper still has more advantages. The accuracy rate of the system in this paper is the highest, with an average accuracy rate of 81.59%. However, the accuracy rates of literature and literature are 62.72% and 46.95% respectively.

## 4. Conclusions

As the core business of electric power system, electric power marketing has been improved and sublimated on the basis of the four-tier structure proposed by the former State Electric Power Company, with more business information interaction and closer cross-departmental business process collaboration, thus forming a network electric power marketing application. In recent years, RPA technology has become more and more popular. As a supplement to traditional platform development methods, it has strong advantages in specific application scenarios and requirements. Its characteristics of low cost, customization and independent operation can give full play to the advantages of independent research and development. Therefore, based on RPA, this paper will study the automatic management of electric power marketing charges, and build an automatic management system of electric power marketing charges. Through the comparative analysis of experimental data, the experimental results of the response accuracy of different systems show that this system is still more advantageous, and the accuracy of this system is the highest, with an average accuracy of 81.59%. However, the accuracy of reference and reference are 62.72% and 46.95% respectively. The system realizes the accuracy, reliability and timeliness of automatic meter reading data transmission and processing through automatic electric energy billing system, meter reading function of integrated electric load management system and electric power marketing management information system. Only by realizing the closed-loop control of computer network process and forming an organic network system as a whole can RPA play a greater role in power marketing.

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