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Research on the Development and Application of Intelligent Financial Profitability Analysis Robot Based on RPA

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Abstract: In the context of accelerating digital economy penetration, financial digital transformation has become a critical pathway for enterprises to enhance core competitiveness. Robotic process automation (RPA) technology, with its efficiency, precision, and cross-system collaboration capabilities, provides innovative solutions for financial process innovation. This paper develops an intelligent financial profitability analysis robot based on Laiye Technology's UiBot platform, focusing on core processes such as data collection, metric calculation, and report generation. It achieves full-process automation from multi-source data integration to visualized analysis reports. By integrating dual-dimensional metrics of accounting profits and cash flows, the system constructs dynamic analytical models adaptable to various industries, effectively addressing issues like inefficiency, high error rates, and delayed decision-making in traditional financial analysis. Practical results demonstrate that the robot achieves over 98% data collection accuracy, reduces business processing time to 30% of manual operations, significantly lowers corporate financial operational costs, and provides real-time, precise decision-making support for management. This solution holds significant practical value and promotion potential.

Keywords: RPA technology; Intelligent finance; Profitability analysis; Robot development; Financial digitization

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1. Introduction

1.1. Research background

As market competition intensifies, businesses are demanding greater timeliness and precision in financial analysis. Traditional financial profitability analysis relies on manual processes for data collection, organization, calculation, and report generation. This approach not only incurs substantial labor costs but also risks human error, resulting in delayed analysis outcomes that fail to meet dynamic decision-making needs. Statistics show that traditional finance departments spend approximately 60% of their working hours on repetitive data processing, with less than

30% of their efforts dedicated to value analysis and decision support.

Against this backdrop, robotic process automation (RPA) technology emerged as a game-changer. As an automated tool that mimics human operations, RPA can work 24/7 under predefined rules, efficiently handling cross-system data exchanges and repetitive tasks. It has already demonstrated significant advantages in fields like financial reimbursement and tax filing. Forrester predicts that the global RPA market will reach $22.5 billion by 2025, with the financial sector contributing over 35% of the market share, making it the most mature vertical application area for RPA.

1.2. Research significance

Theoretically, this research bridges RPA technology with in-depth financial analysis, proposing an integrated framework that enriches the applied intelligent finance domain. Practically, the developed robot automates the full profitability analysis cycle. It liberates financial personnel from repetitive tasks, enables real-time risk monitoring, and provides a cost-effective, reusable digital transformation model for enterprises, especially SMEs.

1.3. Research content and technical approach

1.3.1. Research content

This paper focuses on the development and application of an intelligent financial profitability analysis robot, with four following key components:

(1) Establishing a multi-source automated data collection system to efficiently extract data from corporate financial systems and platforms like Tonghuashun Finance;

(2) Developing a dynamic profitability analysis model that integrates multi-dimensional metrics and optimizes industry-specific algorithms;

(3) Creating visual report generation and anomaly alert modules to enhance the practicality of analytical results and decision support capabilities;

(4) Verifying the robot's performance and application effectiveness through real-world scenario testing.

1.3.2. Technical approach

This study follows a technical roadmap of "requirement analysis-system design-development implementation-testing optimization" using steps as follows:

(1) Identify the core requirements and business processes for corporate financial profitability analysis;

(2) Design the functional architecture and technical solutions for the robot based on the UiBot platform;

(3) Implement the module functionalities using Python programming and Excel advanced functions;

(4) Optimize the robot's performance and stability through simulation testing and real-world application scenarios.

2. Literature review

In the digital economy context, RPA technology has become a crucial tool for driving financial digital transformation. Pang pointed out that RPA financial robots, through simulating manual operations, cross-system collaboration, and round-the-clock operation, have been widely applied in the financial sector. They are evolving from single efficiency tools into "intelligent partners" with smart analysis and decision-support capabilities, providing a theoretical foundation for building intelligent financial analysis systems [1]. In research on financial digital transformation in higher education, Chen believes that RPA financial robots can effectively address issues such as complex financial processes, high repetition rates, and elevated labor costs in universities, demonstrating significant advantages in fund management, tax management, and budget management. The study also emphasizes the need for system maintenance upgrades and the cultivation of interdisciplinary talent to ensure stable RPA application [2].

From the perspective of financial accounting, Shuang developed an RPA-based intelligent financial accounting model for universities. Research indicates that RPA technology can significantly improve accounting efficiency and data accuracy while reducing human error rates. However, its effectiveness still depends on optimizing business processes and improving management system coordination, offering practical references for expanding RPA into financial analysis [3]. In the healthcare industry, Zhang and Yin analyzed the application effectiveness of intelligent financial robots in scenarios such as invoice processing, voucher generation, risk alerts, and financial report analysis using public hospitals as examples. The study concludes that intelligent financial robots enhance financial management efficiency, strengthen compliance control and risk prevention capabilities, and play a significant role in upgrading financial management models [4]. In corporate financial practices, Liu highlighted that the application of financial robots in corporate financial activities can effectively enhance work efficiency and quality, serving as a crucial pathway to promote intelligent financial development and helping to free up financial personnel for analytical and managerial functions [5]. Wang, using state-owned enterprises as examples, analyzed the application effects of RPA intelligent financial robots under the background of digital and intelligent financial transformation. The study revealed that RPA projects not only reduced labor costs and error rates but also improved financial management efficiency and decision support capabilities [6].

In summary, existing research has validated the application value of RPA financial robots across multiple industries, yet systematic studies focusing on in-depth financial analysis scenarios such as profitability analysis remain relatively insufficient. Therefore, conducting research on the development and application of RPA-based intelligent financial profitability analysis robots holds significant practical implications.

3. Relevant theories and technical foundations

3.1. Principles of RPA technology

RPA is a technology that automates repetitive and standardized tasks by simulating human operations on computers through predefined rules. Its core advantage lies in non-invasive integration, enabling cross-platform and cross-system data interaction and process automation without modifying existing information systems. RPA technology primarily consists of three components: process designers, robotic actuators, and control centers. It supports various operations such as screen scraping, data entry, and rule evaluation, capable of processing structured data and fixed-format documents. The entire operation process is fully traceable, meeting the compliance requirements of financial work.

3.2. Indicator system for financial profitability analysis

Profitability analysis constitutes the cornerstone of corporate financial evaluation, assessing a company's profit-generating capacity through financial metrics. This study establishes a comprehensive framework integrating both accounting profit and cash flow dimensions. Accounting profit indicators, such as Return on Equity (ROE), Net Profit Margin, and Return on Assets (ROA), measure profitability scale and efficiency, while cash flow metrics like Earnings Per Share (EPS) and Earnings Quality Ratio (EQR) demonstrate the authenticity and sustainability of profits. Cross-analyzing these multi-dimensional indicators enables a more holistic and objective assessment of a company's profitability.

3.3. The integration logic between RPA and financial analysis

The integration of RPA with financial profitability analysis demonstrates inherent compatibility. Financial profitability analysis involves processes such as data collection, metric calculation, and report generation, all of which feature well-defined rules and high repeatability, perfectly suited for RPA applications. Automating these processes through RPA effectively addresses traditional challenges like time-consuming data collection, high computational error rates, and delayed report generation. Moreover, RPA's cross-system collaboration capability breaks down information silos, enabling centralized integration of multi-source financial data to provide more comprehensive data support for profitability analysis.

4. Design and development of intelligent financial profitability analysis robot

4.1. Overall architecture design of the robot

Based on the concept of functional modularization, the robot adopts a three-tier architecture design consisting of: data acquisition layer, model computation layer, and result output layer as outlined:

(1) Data collection layer: This layer extracts data from multiple sources including corporate financial systems, Tonghuashun Finance, and tax platforms, covering core financial statements such as balance sheets, income statements, and cash flow statements, along with relevant business data;

(2) Modeling layer: Integrates dynamic profitability analysis models to enable automated calculation, cross-analysis, and industry benchmarking of multi-dimensional metrics;

(3) Output layer: Generate visual analysis reports with dynamic charts, metric interpretations, and anomaly alerts. Supports report export and online viewing.

4.2. Development of core functional modules

4.2.1. Multi-source data automation collection module

The data collection script developed on the UiBot platform automates multi-source data acquisition through simulated login, screen scraping, and API calls. Customized solutions are designed for different data sources. For internal platforms like corporate financial systems, UI automation simulates manual operations to precisely capture target data whereas for external platforms such as Tonghuashun Finance, web crawlers retrieve publicly available financial data. For offline files in PDF or Excel formats, OCR technology combined with Excel advanced functions enables data extraction and standardization. A data validation mechanism ensures accuracy through field matching and logical checks, achieving a collection accuracy rate exceeding 98%.

4.2.2. Dynamic profitability analysis module

The system integrates accounting profit and cash flow metrics to build a dynamic analytical framework. For instance:

(1) Python scripts automate metric calculations, with ROE decomposed using the DuPont analysis method and net profit margin benchmarked against industry averages;

(2) An industry-specific weighting mechanism optimizes metric logic based on sector characteristics,

enhancing analytical adaptability;

(3) Data cleaning techniques eliminate outliers and missing values, ensuring calculation error rates remain below 2%.

The model supports rapid adaptation across industries including manufacturing and retail, allowing users to customize metric weights and analytical dimensions as needed.

4.2.3. Visualization report and abnormal alert module

Using Excel visualization tools and Python data visualization libraries, we generated analytical reports featuring dynamic charts and textual interpretations. The reports include summary tables, trend charts, and industry benchmarking radar charts to visually present the company's profitability status. Additionally, we developed an anomaly alert module with preset thresholds such as profit margin fluctuations ≥ 10% and ROE significantly below industry averages. When abnormal indicators are detected, the system automatically triggers notifications via email or system messages, enabling management to complete strategic adjustments within 48 hours.

4.2.4. Process automation control module

The system features a closed-loop control process with "trigger-execution-feedback" functionality, supporting both scheduled and manual triggering modes. Scheduled triggering allows users to set up daily, weekly, or monthly automatic analysis tasks, while manual triggering enables real-time activation of the system as needed. The control module continuously monitors process execution status, automatically initiating breakpoint resumption and error retry mechanisms to ensure stability during network outages or data loss. Additionally, it automatically logs operation details including data sources, processing times, and computational results, meeting compliance audit requirements (**Figure 1**).

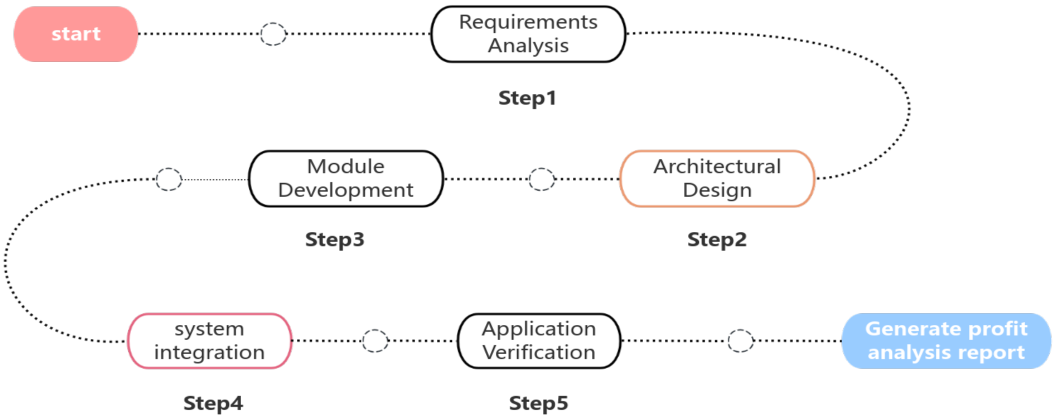

Figure 1. Flowchart of robotic technology for profitability analysis in intelligent finance.

4.3. Development tools and technology selection

The tools and selection are as follows:

(1) Core development platform: Laiye Technology's UiBot, designed for workflow design and automated script development. It supports both visual programming and code editing modes, catering to developers with varying technical backgrounds;

(2) Programming tools: Python is used for metric calculation, data cleaning, and anomaly detection, with Pandas for data processing and Matplotlib for visual chart generation;
(3) Data processing tools: Excel advanced functions (e.g., VLOOKUP, INDEX-MATCH) for data formatting and auxiliary calculations;
(4) Auxiliary tools: OCR technology for processing scanned documents, images, and other unstructured data to enhance data collection comprehensiveness.

5. Robot application testing and effectiveness evaluation

5.1. Test environment and scenario design

The testing environment is built on Windows 10 operating system, equipped with an Intel Core i5 processor and 8GB RAM, and compatible with enterprise-standard financial software (e.g., Kingdee, Yonyou) and office applications. Two representative companies from the manufacturing and retail sectors were selected to simulate the full financial profitability analysis process. Key metrics evaluated included data collection accuracy, indicator calculation error rates, business processing efficiency, and report generation quality.

5.2. Analysis of test results

The robot successfully automated multi-source data collection, covering all core financial data of two enterprises with an accuracy rate of 98.5%. Minor errors occurred only in a few non-standard format data, which could be corrected after manual review. The error rate of key indicators is controlled within 1.8%, meeting the precision requirements for financial analysis. Core metrics like ROE and net profit margin are calculated with absolute accuracy, achieving consistency with manual calculations. A single enterprise's full-process analysis now takes just 15 minutes, a 93.75% reduction from traditional manual operations (averaging 4 hours), significantly boosting analytical efficiency. The generated visual report is logically clear and data-rich, with dynamic charts intuitively showing trend changes. The anomaly alert module accurately identifies three potential risk points for the two enterprises, providing effective support for decision-making.

5.3. Evaluation of application effect

5.3.1. Efficiency improvement

Robots liberate financial staff from tedious tasks like data collection, calculations, and report generation, reducing the financial analysis cycle from days to hours and significantly boosting efficiency. Test data shows these systems can cut HR costs in finance departments by over 40%, allowing professionals to focus on more strategic financial planning and risk assessment.

5.3.2. Precision assurance

Through automated execution and multi-layer data verification, the system effectively reduces human operational errors, with the indicator calculation error rate controlled below 2% and data collection accuracy exceeding 98%. This significantly enhances the reliability of financial analysis results, providing management with precise data support for decision-making.

5.3.3. Strengthening decision support

The real-time monitoring and anomaly alert features empower enterprises to promptly identify profit trend shifts and latent risks, reducing decision response time from days to 48 hours. This enables businesses to swiftly adjust strategies and enhance market adaptability.

5.3.4. High reusability

The robot has developed a standardized solution template, including a code repository, test cases, and operational documentation. This template can be quickly adapted to meet the industry-specific characteristics and personalized needs of different enterprises, thereby lowering the threshold and costs for SMEs to achieve financial digital transformation.

6. Conclusion and outlook

6.1. Research findings

This study develops an intelligent financial profitability analysis robot based on RPA technology. Through functional modules including automated multi-source data collection, dynamic indicator model computation, visualized report generation, and anomaly alerts, the system achieves full-process automation of financial profitability analysis.

The test results demonstrate four key advantages as follows:

(1) Significantly improves analytical efficiency, reducing business processing time to under 30% of manual operations;

(2) Ensures analytical accuracy with over 98% data collection precision and ≤ 2% indicator calculation error rate;

(3) Enhances decision support by improving corporate response speed through real-time alert mechanisms;

(4) Offers strong reusability and industry adaptability, providing standardized solutions for diverse enterprises.

The application of this robot effectively transforms financial analysis from "post-event statistics" to "pre-event warnings and in-process controls", offering a practical pathway for corporate financial digital transformation.

6.2. Existing limitations

While robots have demonstrated promising application outcomes, they still face three key limitations:

(1) Their processing capacity for unstructured data remains constrained, with recognition accuracy needing improvement for handwritten invoices and irregular-format reports;

(2) Their adaptive capabilities are inadequate, requiring manual rule reconfiguration whenever corporate financial processes or data formats change;

(3) Industry-specific adaptation depth is insufficient, failing to adequately support customized metrics and analytical logic in specialized sectors.

6.3. Future outlook

Future enhancements can be achieved through the following approaches:

(1) Integrating generative AI with OCR technology to boost unstructured data processing capabilities and expand data collection scope;

(2) Implementing machine learning algorithms to enhance robots' autonomous learning and adaptive capabilities, enabling automated optimization of process rules;

(3) Deepening industry-specific customization by refining metric systems and analytical models tailored to

sectoral characteristics, thereby improving industry adaptability;

(4) Expanding application scenarios by extending robotic functions to budget management, cost control, and related domains, establishing a comprehensive intelligent financial analysis framework.

With the continuous advancement of digital technologies, RPA applications in finance will deepen further, driving transformative changes in corporate financial management.

Disclosure statement

The author declares no conflict of interest.

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