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Investigation into the Development of Intelligent Financial Management Systems Based on Artificial Intelligence

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Abstract. Artificial intelligence technology is primarily used to create and investigate methods of simulating human brain thinking. It is a new science and technology that extends current science and technology. In a theoretical sense, AI technology is a branch of computer science. We can create an intelligent machine similar to how humans think about problems by researching AI technology. The innovative financial management system has been gradually integrated into artificial intelligence technology. Artificial intelligence has endowed the intelligent financial management system with multi-agent systems, pattern recognition, expert techniques, and other vital technologies. Based on the influence of AI on financial information technology and financial management functions, this paper explores a new financial management model in the era of AI. It constructs an intelligent financial management system based on AI. It will assist businesses in utilizing intelligent technological resources to undertake forward-looking assessments, prevent financial risks, enhance the efficiency of financial management, and achieve tremendous company success.

Keywords: Artificial intelligence, smart finance, management system, innovative research

1. Introduction

Accounting is a part of financial management in the broadest sense[1], taxation[2], auditing[3], budget and debt management[4], investment[5], financing, and business decision-making[6]. Artificial intelligence, the Internet, and other technologies have produced intelligent financial management. Increased space and a more creative approach to reforming and upgrading corporate finance management are made possible by its growth. When it comes to large data, simple financial accounting has been difficult to adapt to the needs of modern enterprise decision-making management. In other words, to adapt to the current social and economic development, enterprises must seek breakthroughs and changes in financial management. Therefore, it is an inevitable trend for enterprises to achieve intelligent financial models and promote economic transformation with the help of artificial intelligence. This study presents a framework for intelligent financial management systems based on artificial intelligence as a reference for the development of intelligent financial management systems.

2. The fundamental structure of an artificial intelligence-based intelligent financial management system

2.1 Definition of artificial intelligence-based intelligent financial management

Through a comparative study of different viewpoints on intelligent financial management, it is believed that innovative financial management can be summarized as follows: Using a human-computer integrated intelligent system made up of financial specialists and intelligent machines, astute financial management is based on cutting-edge financial management theories, tools, and methodologies; financial accounting and supervision are handled using engines, complex economic activities are organized and differentiated financial relationships are handled through human-computer collaboration, it provides enterprise managers with forward-looking, logical and differential analysis[7]–[9]. Using a human-computer integrated intelligent system of financial specialists and intelligent machines, astute financial management is based on cutting-edge financial

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management theories, tools, and methodologies; financial accounting and supervision are handled using engines.

2.2 The structure of an artificial intelligence-based intelligent financial management system

As shown in Fig 1, Using a human-computer integrated intelligent system made up of financial specialists and intelligent machines, astute financial management is based on cutting-edge financial management theories, tools, and methodologies; financial accounting and supervision are handled using engines.

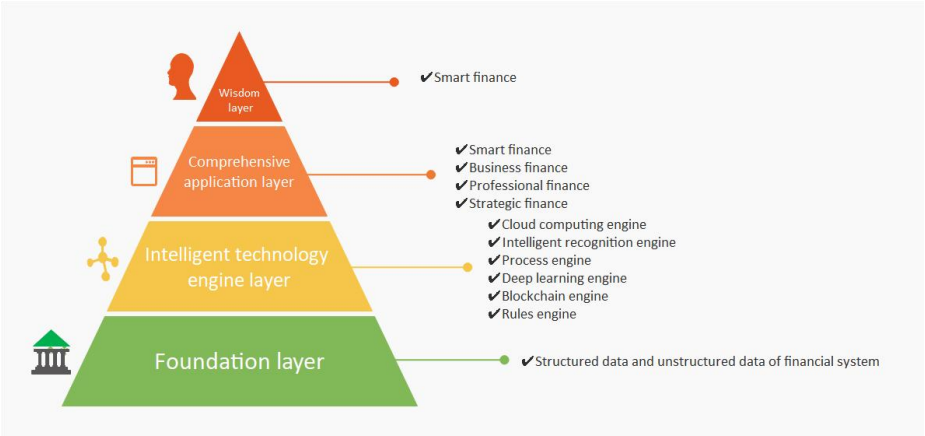

Fig 1. An AI-powered financial management framework

3. An AI-powered, financially-savvy method of management

3.1 Database layer

The database layer is the foundation of intelligent technology's efficient functioning. In the age of artificial intelligence, examining both organized and unstructured data is essential. The system's structured data must tag all pertinent business data. When a transaction takes place, Tags associated with a transaction are recorded at the database level. As much unstructured data as feasible must be gathered, processed, and stored using big data technologies to support the many use cases for those technologies. Structured and unstructured data have appropriate functional support in the system, including docking management, collection management, exchange management, storage management, etc., all of which are part of the data foundation layer. Building a solid and stable database plays a good role in laying the groundwork for machine learning and the construction of intelligent engines, which is also an essential change in the financial management system based on artificial intelligence.

3.2 Intelligent technology engine layer

As shown in Fig 2, An essential part of AI-based intelligent financial management is the intelligent technology engine layer. The intelligent recognition engine is an optical character recognition (OCR) system that uses deep learning. The rule engine takes the tag as the element, reasonably expresses, encapsulates, and forms a rule package for the control rules through specific machine language, and carries out automatic logic processing in real time; With extreme flexibility and scalability, the process engine supports complex background task path diversion in intelligent applications. A learning engine is a critical component of AI technology. The cloud computing engine provides massive computing power and programs for various rules and algorithms; The blockchain engine realizes the parallel bookkeeping of each department when each transaction occurs and offers technical support for processing complex matters such as business financial consistency checks.

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3.3 Detailed application layer

The intelligent financial management system based on AI relies on the extensive application layer as its backbone. It contains four specific operation levels, as shown in Fig 1, respectively: 2) Business finance, which is essentially the extension of professional finance in the business scope of enterprises, involving the financing of the supply chain, product development, marketing activities, industry finance integration, and other links; 3) Strategic finance, which is the culmination of professional finance and an essential component of financial management, including many fields such as financial tax management and risk management. There is an emphasis on value management, total budget management, etc., in its pages; Fourthly, intelligent finance may serve as a stepping stone to more advanced forms of financial management. Management, process, operation, organization, and management are all set to jump to intelligent financial management with the help of the intellectual sharing center.

3.4 Smart financial layer

The original general transactional process field has been replaced with the high-value process field. Fund management, current accounts, the public ledger, asset management, expenditure reimbursement, etc., comprise the general transaction process; the fields of tax analysis, corporate governance, capital operation, forecasting and decision-making, internal auditing, and risk management all rank among the highest in terms of value creation. Using this "upgraded version" of financial management, innovative finance prioritizes the hierarchical application of differentiated management, shifts the focus from the traditional financial closed-loop direction to interactive management, and ultimately increases an enterprise's practical competitiveness.

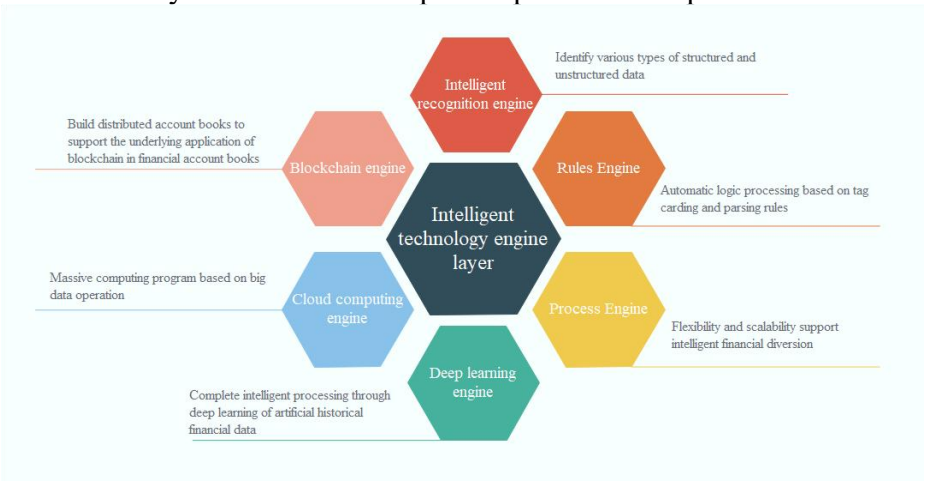

Fig 2. Composition of intelligent technology engine layer

4. Integral AI tools for modern financial management

4.1 Operation mode based on multi-agent

The intelligent financial management system's overall operation mode is multi-agent[10]. The term "agent" originated from the field of distributed artificial intelligence in the 1970s[11]; the word "agent" is used to describe a system that can independently operate, observe its surroundings in a changing environment, and draw conclusions based on those observations and the data it has gathered. Problems that a single agent cannot handle may be tackled effectively by a multi-agent system, wherein several agents coordinate their efforts via negotiation, communication, and collaboration[12]. Intelligent financial management based on a multi-agent system is to receive structured and unstructured data information from the external environment through sensors for perceptual input, combine the internal state for data and information fusion, task allocation and operation processing, reasoning, and planning under the guidance of the knowledge base, and

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generate models and algorithms, and generate corresponding action sequences or rules under the direction of the goal intention. The resultant integrated actuator acts on the external environment, thus completing the whole process from receiving information to operating processing, updating feedback, and intellectual output. As shown in Fig 3, The three main tiers of a multi-agent system's operating mode for intelligent financial management: are perceptual input, operational processing, and intellectual output, which correspond to the system's database layer, engine layer, integrated application layer, and intelligent layer.

Each agent in the multi-agent model studied here represents a different part of an IFM system and the underlying distributed planning methodology. A complete running process requires that each component separately gathers information about the surrounding environment and the operating state of its neighbors and then adapts its behavior to the dynamic changes in the surrounding environment. Specifically, each multi-agent element in the intelligent financial system can be represented by an undirected graph $G=(V,E)$ illustrating n vertices, $E=(e_1,e_2,\ldots,e_m)$ which means m edges. If it is used $|V|$ to describe the vertex number, $|E|$ it means the number of sides. Each vertex in the undirected graph represents an agent. According to the rigid formation principle of multi-agent, when it is established $|E|=2|V|-3$, the multi-agent corresponding to the undirected graph reaches a relatively stable state. The running process of the system is a process in which agents change from disorder to order and keep running. In this paper, the potential field function theory between agents is introduced; that is, when the distance between two agents is less than the specified threshold, repulsion will be generated, and when the space is greater than the specified threshold, gravity will be caused, until each agent finally reaches a stable running state. From the perspective of system operation, it means that all tasks and all levels get a steady operating state through constraint rules (potential field functions). The following smooth potential field function can represent the model:

$$V_{ij}\left(\left\|x_{ij}\right\|\right)=\begin{cases} a\ln\left\|x_{ij}\right\|^2+\dfrac{b}{\left\|x_{ij}\right\|^2}, 0<\left\|x_{ij}\right\|,\ \sqrt{\dfrac{b}{a}} \\ a\ln\left\|x_{ij}\right\|^2+\dfrac{b}{\left\|x_{ij}\right\|^2}+\cos\left(1+\dfrac{\left\|x_{ij}\right\|^2-\dfrac{b}{a}}{R^2-\dfrac{b}{a}}\right)\pi+1, \sqrt{\dfrac{b}{a}}<\left\|x_{ij}\right\|<R_d \\ a\ln\left\|x_{ij}\right\|^2+\dfrac{b}{\left\|x_{ij}\right\|^2}+2,\ \text{Others} \end{cases} \tag{1}$$

In the formula, a, b and R_{d} are average numbers, and have the following relations: $b>e/a$, $R_{\mathrm{d}}>\sqrt{b/a}$, V_{ij} are potential field functions between agent i and agent j; x_{ij} is the distance between them. As you can see, V_{ij} it is continuous and differentiable everywhere. From the above characteristics V_{ij}, we can get the potential field function of the agent i:

$$V_i=\sum_{j\notin N_i}V_{ij}(R)+\sum_{j\in N_i}V_{ij}\left(\|x_{ij}\|\right) \tag{2}$$

The control law u_i of the agent i is further obtained:

$$u_i=-\sum_{j\in N_i}\nabla_{x_i}V_{ij}-\sum_{j\in N_i}w_{ij}\left(v_i-v_j\right) \tag{3}$$

The formula w_{ij} is the weight coefficient of each side, which in the intelligent financial model corresponds to the contact tightness between the elements.

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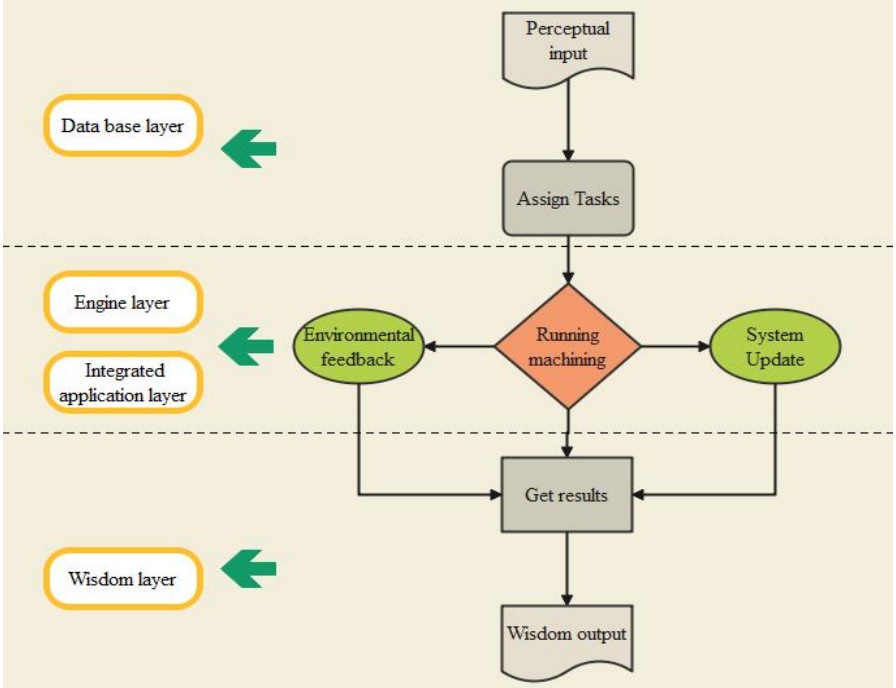

Fig 3. The operating method of multi-agent-based intelligent financial management

4.2 Information processing based on pattern recognition

The pattern recognition system[13] applied in intelligent financial management mainly refers to classifying and processing information with specific characteristics or various forms in financial management and then analyzing this information one by one. This information generally includes numerical, literal, and logical relationship information, etc. We can explain and identify the corresponding facts in financial management by processing and analyzing this information. The pattern recognition system used in intelligent financial management mainly uses statistical and fuzzy pattern recognition methods to identify.

In the application process of statistical pattern recognition[14], it is mainly described by the feature vectors in financial information, and the elements of each feature vector represent a feature or attribute of the pattern. Then, these feature vectors are used to form the corresponding space. In intelligent financial management, data self-acquisition, data processing, characteristic selection, and classification selection are realized through this mode. In this way, various data features in financial information can be classified and identified by the computer, and valuable data in financial information can be summarized to restore corresponding data. The primary method is the support vector machine. SVM seeks to locate a hyperplane such that various sorts of training sample points fall on both sides of the hyperplane. In addition, the blank spaces on both sides of the hyperplane must reach their maximum size and eventually accomplish financial information recognition.

$$L=\frac{1}{2}\| w\|^2-\sum_{i=1}^{l}\alpha_i y_i\left(w\cdot x_i+b\right)+\sum_{i=1}^{l}\alpha_i \tag{4}$$

Where $\alpha_i>0$ is the Lagrange coefficient, and the optimal classification function obtained after solving the above problems is:

$$f\left(x\right)=\operatorname{sgn}\left\{\left[\sum_{j=1}^{l}\alpha_j^* y_j\left(x_j\cdot x_i\right)\right]+b^*\right\} \tag{5}$$

In linear inseparability, The core idea behind support vector machines is to find the optimal classification plane in a high-dimensional feature vector space by mapping the input vector. When x the non-linear mapping $\Phi:\mathrm{R}^n\to H$ H is made to high-dimensional feature space, there are:

$$x\to\Phi\left(x\right)=\left(\Phi_1\left(x\right),\Phi_2\left(x\right),\cdots,\Phi_l\left(x\right)\right)^{\mathrm{T}} \tag{6}$$

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The ideal classification function may be derived by solving the system of the equation:

$$f(x)=\operatorname{sgn}\left(\sum_{i=1}^{l}\alpha_i y_i \Phi(x_i)\cdot\Phi(x)+b\right) \tag{7}$$

In the application process of intelligent finance, fuzzy recognition is mainly based on the principle of maximum subordination for recognition and then classifies each financial data model through the corresponding standard model in the computer and the model provided by the database[15]. The basic operation idea of fuzzy recognition is to conduct fuzzy clustering judgment on several known training samples, obtain the corresponding standard sample information, and then identify and calculate the relative membership of the pieces to be selected in each mode. Specific steps include:

1) Standardize financial management data. Suppose the universe $U=\{x_1,x_2,\cdots,x_n\}$ is the classified sample, and each model m has an index to represent its character; that is $x_i=\{x_{i1}x_{i2},\cdots,x_{im}\},(i=1,2,\cdots,m)$, then, the original eigenvalue matrix is obtained as follows:

$$\begin{pmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{pmatrix} \tag{8}$$

x_{nm} Represents the original data of the index m of the classification object n. Different data generally have other measurement units. To compare additional data, it is usually necessary to make an inevitable transformation of its eigenvalue, that is, standardization;

2) Create a fuzzy similarity matrix. The similarity matrix is built based on the standard data. Assume that the maximum and minimum approach is used to determine the correlation coefficient r_{ij} to establish a fuzzy similarity matrix r_{ij} to express the similarity between x_i and x_j.

$$r_{ij}=\frac{\sum_{k=1}^{m}\left(x_{ik}\wedge x_{jk}\right)}{\sum_{k=1}^{m}\left(x_{ik}\vee x_{jk}\right)} \tag{9}$$

3) The membership evaluation is completed according to the similarity matrix. However, in the application process, there are sizeable human interference factors through the pattern recognition system, mainly because fuzzy membership and credibility are determined in advance by the financial staff, so there is much subjectivity in the process of financial data judgment.

4.3 Working mode based on expert system

The expert system[16] utilized in intelligent financial management is a software system with expert-level financial management knowledge. Through the application of this system in financial management and by giving the financial management system the work experience and expertise of experts, the financial system can work like the economics experts in this field so that the related questions can be answered at a higher level in a short time during the financial management process. Expert system applications in intelligent financial management can be realized mainly through a programming language, computer-specific knowledge representation, a processing language, a high-level programming language, an expert system language, etc. The expert system in financial management can combine the corresponding financial management knowledge, financial management experience, and financial management functions into a complete program system. In the financial application process, the expert system can solve various problems in the financial management process. In general, for some relatively complex financial management processes, the various systems in the intelligent financial management process can replace traditional financial management experts. It can also accurately describe the relevant data in financial management,

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diagnose the business reports of enterprises, analyze the operating benefits of enterprises, and verify the financial data of enterprises through a series of empirical studies. At the same time, the expert system can also combine the market and financial management environments in the enterprise's business process to make the final decision on the financial report based on the enterprise's business philosophy.

Conclusion

The advent of AI necessitates the revision of traditional methods of managing money, alters the mode of operation of enterprise financial management, and catalyzes the innovation of enterprise business models. At the same time, it is also an inevitable requirement to achieve sustainable enterprise development and an urgent need to improve the nation's overall strength. The goal of developing an AI-based financial management system is: Responsible use of AI technology and regular updates and conversions of intelligent technology are necessary to develop an AI-based intelligent financial management system. Innovative financial management systems have been a driving force in the modern reform of economic operations and management mechanisms thanks to the advent of artificial intelligence. The intelligent financial management system created by artificial intelligence technology can solve the complex problems in the financial management process of enterprises more efficiently, significantly reduce labor costs, and increase economic benefits. In order to create an AI-powered system for managing money, Implementing AI technology responsibly and regularly updating and converting intelligent technology are essential steps in developing an AI-based intelligent financial management system. Artificial intelligence (AI) has enabled innovative financial management solutions to play a pivotal role in modernizing economic processes and management structures.

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