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Investigation on Library Archives Intelligent Embedded System Based on Artificial Intelligence Technology

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Abstract Library archive management is an important business in the library management system, and the progress of science and technology has made the library archive management system increasingly intelligent. The embedded system has strong real-time and specificity, thus making it suitable for the development of archive management systems. The article introduced the composition and structure of the embedded system, including software and hardware parts. To further improve the efficiency of embedded archive management systems, the article used a deep learning convolutional neural network algorithm model to improve it. The performance of the convolutional neural network algorithm was tested from three aspects: the accuracy of archive system risk prediction, the system's transaction processing ability, and the system's clicks per second. The data showed that the risk prediction accuracy of embedded archive systems under convolutional neural networks was above 0.9. At the 80th experiment, the risk prediction of traditional embedded archive systems decreased to 0.89. The convolutional neural network embedded archive system processed more transactions within a certain response time. The convolutional neural network embedded archive system had multiple clicks during a certain period of time, with a maximum of about 60 clicks per second. The overall click through rate of traditional embedded file systems was below 50 times per second. Therefore, it could be concluded that embedded archive systems based on convolutional neural networks had better transaction processing capabilities and work efficiency.

Index Terms Embedded System, Library Archives, File Management, Artificial Intelligence, Convolutional Neural Network

I. Introduction

The progress of society has led to an increasing level of education among people, and people's access to knowledge has become more convenient. With the increasing demand for books, the number of libraries is also constantly increasing. Therefore, the management of library books and archives has gradually become a complex task. Due to the increasing scale of the library, the traditional library archive management model is outdated, and the procedures are cumbersome. The difficulty of management is significant, and its model can no longer keep up with the development scale of the library and cannot meet the needs of readers. Therefore, it is necessary to improve its management mode. The intelligent management system simplifies its management procedures through intelligent means and saves time. This improves the efficiency of archive management and provides great security for its library archive management. Artificial intelligence technology is constantly updating, and intelligent library archive management technology is also constantly innovating. With the advent of the digital era, the library management archive system is becoming more automated and digitized, thus providing readers with more efficient, fast, and secure services, and improving the level of library informatization.

Library archive management is an important link in library management services, thus covering both reader information and book information. With the increasing scale of the library, library archive management projects have become complex and a hot research topic in library management systems. Arfyanti Ita used information and related technologies to control objectives, thus providing activities in the form of products managed within the framework of the information technology organizational structure. He focused on the execution and control of technology governance information experts, so as to analyze the information system performance of the East Kalimantan Library and Archives department. The results indicated that the libraries and archives offices in the East Kalimantan region needed to use it more effectively to maximize its effectiveness [1]. Maemura Emily examined the decision space of web archiving and its role in shaping both captured and uncaptured content during the web archiving process. By comparing how three different web archives were created and recorded, he investigated how management decisions interacted with technology and external factors, and compared commonalities and differences [2]. Lamba Manika found that there were some unique sub areas in Indian library

and information science research, such as open access, online exhibitions, virtual libraries, multimedia libraries, open source software, library automation, and library management systems. This indicated that over time, new themes emerged and old themes became outdated. Theme modeling could not only help researchers identify their areas of interest, but also help them identify new concepts and domains over time [3]. Bhatia Sharmila provided a brief overview of blockchain or distributed ledger technology for archive administrators and record managers. In the new stage, records were already created or managed by blockchain. It was necessary for archive administrators and record managers to familiarize themselves with the basic knowledge, advantages, and disadvantages of this technology in order to make wise decisions regarding the addition of blockchain systems in managing record authenticity [4]. These studies had certain research value, but most of them were explored from a theoretical perspective.

The application of artificial intelligence in various industries in the market is becoming increasingly common. The improvement of the automation level and digitization of intelligent library archive management is the development trend of future archive management systems, and this field is receiving more and more attention. Cox Andrew M identified some potential roles for academic libraries, such as data acquisition and management, artificial intelligence tool acquisition, and infrastructure construction. He proposed the paradigm of intelligent libraries to capture the potential impact of artificial intelligence on libraries [5]. Rolan Gregory introduced artificial intelligence technology and its characteristics related to recording work, as well as four case studies of Australian archives and government agencies. These institutions started implementing artificial intelligence programs. Finally, he discussed the lessons learned, issues, and impacts of artificial intelligence in archives [6]. These studies had certain reference significance for the intelligent embedded system of library archives, but they were not analyzed based on actual situations.

Introducing the library archive management system into various intelligent devices can greatly improve the efficiency of library work. Developing an embedded system for library archives can improve the intelligence of the system and reduce the complexity of library archive management. This article introduced the embedded system of library archives, and introduces artificial intelligence related technologies, so as to improve its archives management system to further enhance system efficiency, thus making the library archives system more mobile and intelligent.

II. Investigation on Intelligent Library Archive System

II. A. Library Archives Management

Library archive management refers to the use of certain information technology methods to classify, organize, collect, analyze, and manage books and archives in a library. Nowadays, library archive management requires a certain level of computer operation technology and mastery of the latest concepts in book and archive management. Today, with the development of big data and the Internet of Things, various industries are constantly innovating and reforming with the pace of informatization, and archive management is also affected by it. Digital archive management is a new direction of research in the current field. By examining the user service status of digital libraries in the era of big data, it is pointed out that the data resources of modern digital libraries not only have the characteristics of big data, but also require the use of big data methods to achieve reform and innovation in resource transfer, resource utilization, social identity, and thinking innovation [7]. With the expansion of public libraries and the increasing complexity of archive management, there are still certain development issues in the management and utilization of archives in libraries.

II. A. 1) Current Situation of Library Archives Management

The archives of a library play a decisive role in its operation and serve as an important basis for maintaining library work. However, currently, the development technology of archive management in many libraries is not yet mature, thus leading to a series of problems in archive management. The following problems still exist in library archive management:

(1) Archives management personnel are not standardized in their management of archives: Due to the incomplete system of archives management in most libraries, there is no management basis for management personnel. There is a lack of scientificity in the collection, organization, and archiving of archives, and there is no fixed collection time and scope for archives. Various types of archives are not systematically classified, and there is no unified standard. These situations all reflect the non-standard management of book archives.

(2) Lack of talent in the field of archive management: Currently in the initial stage of intelligent and informationized library management, the policies for the utilization and training of professional talents in archive management are not yet perfect. The cultivation of talent teams is an important driving force for the digital construction of library archive management informatization.

(3) Incomplete hardware facilities: Currently, the archive management methods of public libraries in the market are inherited from previous management methods. All traditional archive management work is managed by a single department, thus lacking professional management departments and storage equipment and venues for archives. Part of the reason is also due to insufficient investment in archive management and the lack of frequent replacement of management equipment, which leads to poor conditions and delays in archive management, thus affecting work efficiency.

II. A. 2) Development Direction of Library Archive Management

With the continuous development of science and technology, library archive management is also facing new challenges. This is not only a change in the content of management work, but also a need for further innovation in its management methods. It is necessary to improve and enhance the library's archive management methods from various aspects, and build a complete archive management system. The improvement direction of library archive management can be started from the following points:

(1) The management system needs to be improved and the investment in funds needs to be increased: The norms and systems of traditional archive management can no longer meet the needs of scientific management in the new era. Therefore, it is necessary to improve its archive management system, and continuously innovate and upgrade the management system, so as to help the library effectively carry out its work. It is necessary to learn new technologies, introduce new equipment for archive management, and improve infrastructure, such as specialized archive rooms, specialized archive boxes, archive binding machines, and other equipment, as shown in Figure 1:

Figure 1: Archive management equipment

The archives of a library can reflect the development process of the library and serve as the original evidence for library activities, which can provide an important basis for the development of library work. Therefore, library archive management should be given attention. Establishing a library archive information management system can improve management efficiency, and develop structured and modular initial archive management, so as to improve its archive utilization rate.

(2) The cultivation of professional talents needs to be strengthened: In the new era, library and archive management is facing many requirements and challenges. To improve the level of professionalization of archive management, it is necessary to introduce professional talents. Faced with the increasingly complex situation of archive management work, it is necessary to strengthen talent construction and increase the cultivation of professional talents in the field of library archive management. Firstly, it is necessary to enhance the management and service awareness of archive management personnel. Managers should understand the value of archives, and actively communicate and coordinate with various departments of the library, so as to provide high-quality management and services. Secondly, it is necessary to improve the professional abilities of archive management personnel. Archive management requires certain organizational and management abilities, as well as strong analytical skills. Of course, in the current era of information technology, managers also need to possess certain computer skills and master electronic archive management technology. Finally, it is necessary to strengthen training for management personnel and improve their professional level. They need to improve the quality of management personnel, and provide them with professional knowledge training, so as to learn new skills and technologies, especially computer technology, and focus on training to keep up with the pace of development in the new era.

II. B.Embedded Systems

The development of embedded systems began in the 1970s, and embedded systems were developed on microprocessors. Currently, embedded systems have both software and hardware components. The main function of embedded systems is to be able to run independently, and their systems include independent hardware components such as memory, processors, etc. The software part runs independently using API (Application Programming Interface) programming as the development platform. The basic composition of its system is both its hardware facilities and software system, with the main core component being the central processing unit.

II. B. 1) Hardware Part of Embedded System

The hardware composition of embedded systems is similar to that of other computer systems, but the difference is the application method of their hardware components. Its hardware also includes processors, memory, external devices, Input/Output interfaces, controllers, and other components, which are basic components of ordinary computer hardware. However, for embedded systems, their hardware would not use large capacity storage media because of their slow running speed. Next is the bus part of the embedded system. With the development of its field, the adoption of buses in embedded systems is becoming increasingly personalized based on their actual scale and characteristics. Different embedded systems have different types of buses. The uniqueness of embedded systems gives them advantages such as low power consumption, small size, and strong specificity. For the development of library archive systems, embedded systems can be chosen, which can meet the specific needs of archive utilization and management. Managers can enjoy its functions by turning on the power, and can operate the archive system with simple configuration operations. Protecting digital archives remains a persistent challenge for archivists. Due to rapid changes in format and technology, electronic records may become unreadable [8]. Embedded systems can improve the operability of electronic archives in libraries.

II. B. 2) Embedded System Software Part

The software part of an embedded system is also an important component of its system, and its architecture is similar to that of a regular computer. However, the software architecture of an embedded system differs in that it has high software code quality and strong real-time performance of the operating system. Interconnected devices that support software are crucial, and embedded systems are often used for security and privacy sensitive applications [9]. The software system can be divided into several parts, including the driver layer, operating system, intermediate connection layer, and application layer. Firstly, the driver layer is connected to the hardware part of the system, thus providing hardware drivers for the upper system. Next is the operating system, which is the core part of its system and is responsible for scheduling and controlling embedded systems. The embedded operating system has high efficiency and high-speed running efficiency, and can run stably. Next is the intermediate connection layer, which is used to provide tools for related development software, such as databases, graphics processing tools, network security protocols, etc. The database management system has been applied in library management, and the library has accumulated a large amount of historical data on readers' access to resources [10]. Finally, there is the application layer, which is the implementation of software functions to meet the needs of users. The embedded system would vary according to the actual needs of different users. Therefore, the embedded system has strong dynamism and high professionalism, and can be optimized according to actual needs. A data-driven software platform is crucial for achieving manageable and sustainable intelligent utilities and developing new applications [11]. Figure 2 shows the basic hierarchical structure of the embedded system:

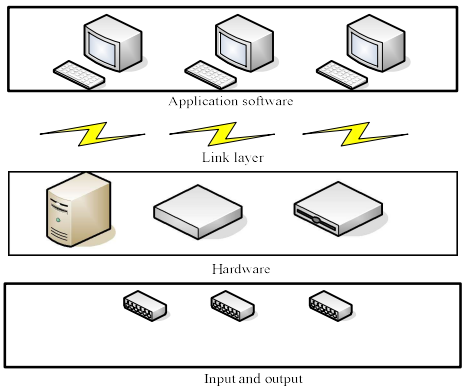

Figure 2: Basic structure of embedded systems

Embedded systems are developed based on actual needs, so they have strong professionalism. For different embedded systems, the development situation, specific functions, and applications have their own characteristics. The system has a small size and low power consumption. The system has strong real-time performance and reliability. Therefore, embedded systems are widely used in multiple fields with these advantages. Developing an embedded archive management system can to some extent replace manual operations, and facilitate regular inspection of archives. It can achieve automation of archive utilization, and enable more accurate intelligent management, so as to maintain the integrity of archive records and provide more secure archive information protection functions.

II. C.Investigation on Artificial Intelligence and Library Archive Management

For the library archive management system, due to its large information system, its utilization and management are relatively complex. To make the system run more efficiently and update archive data in real-time, strong embedded system support is required. For embedded systems, the chip support and processor performance of the system determine the operational efficiency of the system. A chip with better performance can reduce the system's consumption and occupy less physical space during operation, thus improving the system's processor's operational capability. Chips are designed using specific algorithms and computing concepts. The conceptual structure of the neural network model provides new technological support for embedding core technologies, and the neural network model based on artificial intelligence provides a construction concept for the embedded core architecture.

Large scale internet systems are emerging from the assimilation of many aspects such as infrastructure, embedded devices, intelligent objects, humans, and physical environments [12]. The fundamental function of embedded systems is to obtain the eigenvalues of information or data, and extract the eigenvalues to obtain relevant parameters, so as to conduct learning and training to generate sample parameters. The parameters are input into the module of the system to enable the system to work automatically. Therefore, how to improve the operational efficiency and operational accuracy of this process? The deep learning convolutional neural network algorithm model is developed on neural networks, which has better performance in extracting eigenvalues of information data and can meet the needs of extracting and processing a large amount of data information. In the face of a large number of information embedded systems, strong computing speed is needed. Therefore, it is also necessary to improve its algorithm. Convolutional neural networks are divided into convolutional layers and pooling layers. Convolutional layers play a huge role in extracting information feature values, which can extract a large number of features from information data. The convolutional layer has a certain calculation method when extracting features, and the formula is as follows:

$$T = (\frac{t+2P-}{L}) \tag{1}$$

Formula (1) represents the calculation formula for extracting features from convolutional layers. Among them, T represents the size of the output feature vector, and t represents the size of the input feature vector. J represents the size of the convolutional kernel in the convolutional layer, and P is the quantity it fills. L refers to the step size. After extracting convolutional layer features, the quantity of its parameters is then calculated. The number of parameters in each layer is actually equal to the size of the convolutional kernel multiplied by the number of channels of the input feature vector and multiplied by the number of convolutional kernels. Finally, it is converted into the following formula by adding the number of convolutional kernels:

$$C = J \times K \times N_J + N_J \tag{2}$$

In Formula (2), C represents the number of parameters; K represents the number of channels of the feature vector; N_J represents the number of convolutional kernels. Finally, the calculation of computational complexity can be expressed as the following formula:

$$W = J_i * J_i * T * t \tag{3}$$

In Formula (3), it can be seen that the calculation formula for its computational complexity is equal to the product of the size of the convolutional kernel plus the size of the input and output feature vectors. The above is about the principle of convolutional neural networks for extracting information features. Convolutional neural networks, due to their deeper network structure than neural networks, belong to the field of deep learning and can handle multiple inputs of information. This principle is applied to embedded systems, and its convolutional neural network algorithm can automatically filter out convolutional kernels that have a significant impact on performance. This method can keep the system in an efficient running state, thus making it more stable.

The construction of an efficient library archive embedded management system requires hardware support, and the algorithm performance of software development also plays a decisive role. Artificial intelligence uses mathematical algorithms to mimic human cognitive abilities [13]. The method of artificial intelligence deep learning is used to build an embedded software system platform, which provides technical support for library archive systems and improves their modularity. This enables faster organization, collection, and analysis of archival information. Convolutional deep learning based on deep learning has good performance in extracting information feature points, and can handle a large amount of archival information and data. Digital protectionists and information scholars urgently need to consider how to collect and manage records in a constantly changing information environment [14], and improve the efficiency of archive system management. The following is an experimental analysis of its algorithm performance.

III. Simulation Experiment of Embedded Archive System Based on Convolutional Neural Network

Embedded systems can provide human-computer interaction interfaces, thus allowing archive managers to better operate system functions and further provide convenience. The sensing technology of the system can promote information transmission and sharing, and the library archive management system is also a huge information exchange platform. Existing artificial intelligence solutions typically run on powerful platforms with high availability of computing resources [15]. The development of chip technology in embedded systems and the construction of software platforms can all utilize deep learning algorithm models. This article introduced the principle of convolutional neural networks and their applications in embedded system development. The performance of convolutional neural network algorithms would be tested from three aspects: the accuracy of risk prediction in archive systems, the system's ability to process transactions, and the system's clicks per second. Firstly, the experimental environment was provided, as shown in Table 1:

Table 1: Setting of experimental environment

Project	Monitoring method
Content	Three-level monitoring
Voltage	220v
Hard disk capacity	500GB
Monitoring instructions	Cache instruction

The following is the accuracy test for risk prediction of embedded archive systems:

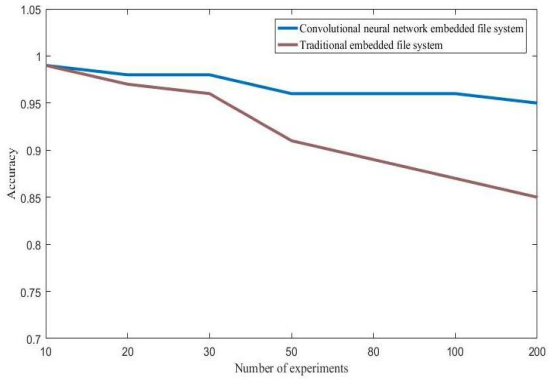

Figure 3: Accuracy of file risk prediction under different algorithm systems

Figure 3 showed the accuracy of archive risk prediction for traditional embedded archive systems and embedded archive systems controlled by convolutional neural networks. Risk prediction was crucial for archive systems, so the system's risk detection ability was tested through multiple experiments. From the line chart distribution in the figure, it could be seen that with the increase of the number of experiments, the accuracy of risk prediction of the two algorithm systems declined. However, it was evident that the accuracy of risk prediction in traditional embedded archive systems decreased by a greater extent. The data showed that the risk prediction accuracy of embedded archive systems under convolutional neural networks was above 0.9. In the 80th experiment of the traditional embedded archive system, the risk prediction of the archive system decreased to 0.89.

It could be seen that the embedded archive system prediction of convolutional neural networks was more accurate. Therefore, it could be concluded that a convolutional neural network embedded archive system based on deep learning could provide a more secure guarantee. Next, from the transaction volume processed by the system every second, its performance was tested:

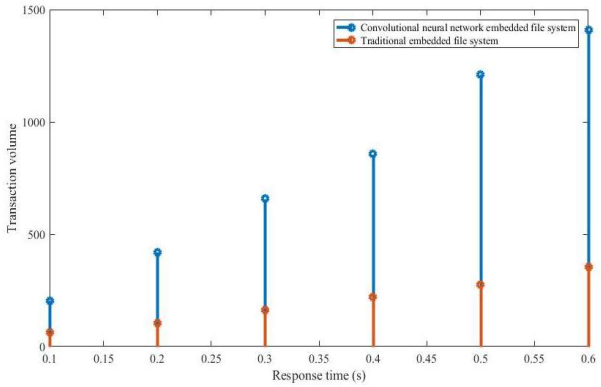

Figure 4: Transaction volume processed by different archive systems

Figure 4 showed the transaction volume processed by two embedded archive systems within a certain period of time. The processing speed of transaction volume was an important indicator for testing system performance. The transactions processed by general file systems were complex, and the system needed to receive multiple transaction requests at the same time. Therefore, by testing traditional embedded archive systems and embedded systems controlled by convolutional neural networks, it could be seen that convolutional neural network embedded archive systems processed more transactions within a certain response time. The data showed that within the time range of 0.1s-0.6s, the transaction volume of the convolutional neural network embedded archive system increased from 205 to 1408, while the transaction volume of the traditional embedded archive system was 62-356. It could be seen that the embedded archive system of convolutional neural networks processed more transactions within a certain period of time and had good performance. Next, the system's clicks per second were tested.

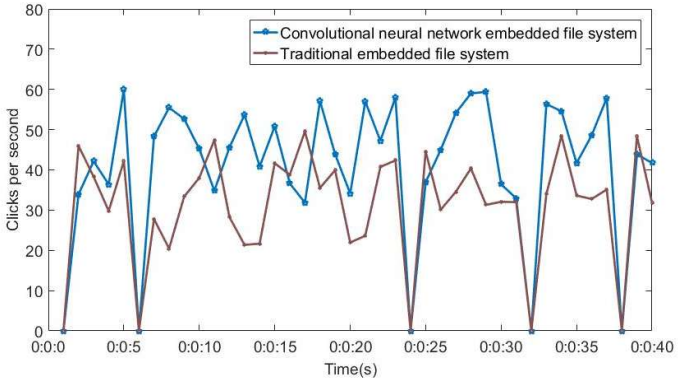

Figure 5: Hits per second for different algorithm systems

Figure 5 showed the number of clicks per second by users when using the file system. The number of clicks per second was also one of the indicators for testing system performance. Figure 5 showed the line chart of hits in 0s-40s. Within these 40 seconds, the click through volume of the file system varied every second. From the data, it could be seen that the click through volume of embedded archive systems under convolutional neural networks was slightly higher than that of traditional embedded archive systems during the time period. The convolutional neural network embedded file system had multiple clicks reaching nearly 60 per second during this time period, while the overall clicks per second of traditional embedded file systems were below 50. From this, it could be seen that the convolutional neural embedded archive system could accept more clicks, indicating that its system ran better.

IV. Conclusions

The library archive management system is facing new reforms. By utilizing the real-time and specialized advantages of embedded systems, they can be applied to intelligent management of library archives, which can produce good results. In order to improve the system's operational efficiency and transaction processing ability, this article conducted research on embedded archive systems based on artificial intelligence technology. The article introduced the current forms of library archive management and some existing problems. In the era of big data, archive management should shift towards digital information management. Therefore, this article introduced the concept of embedded systems and their basic components, including the hardware and software components. Finally, the deep learning convolutional neural network algorithm was used to improve its system performance. In the experimental analysis section, the performance of the convolutional neural network algorithm was tested from three aspects: the accuracy of risk prediction in the archive system, the system's transaction processing ability, and the system's clicks per second. The conclusions drawn from the data indicated that the embedded archive system controlled by convolutional neural networks could better predict risks and had stronger transaction processing capabilities. The system could withstand more clicks. Overall, the system performance and operational efficiency were better.

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