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Application analysis of process state control in modern operating system

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Abstract: *In modern computer operating systems, the concept and application of processes are widely applied in various fields. In this article, the light balancing process of book barcodes is taken as a practical case, and the processes in computer operating systems are analyzed as the object of analysis. The working methods of processes, domestic and international development situations, and analysis and prediction of future development are analyzed. It plays a certain role in understanding and summarizing the work of computer systems.*

Keywords: *Operating system; Process; Development analysis; Light balance*

1. Introduction

The focus of this article is on the research of book barcode light balancing technology based on image processing. In daily learning and life, borrowing books from libraries or purchasing books from bookstores is a way for the public to obtain information on paper books. With the development of technology, the service methods of libraries and bookstores have become more diversified. However, due to environmental factors, problems often arise in the recognition of book barcodes. This is because the recognition of barcodes requires certain lighting requirements, and when the light is too strong or too dark, the barcode of books is not easy to be recognized. Therefore, in this project, this article aims to use relevant technologies to achieve faster and more accurate recognition of book barcodes by machine equipment.The composition of the barcode information recognition system is shown in Figure 1.

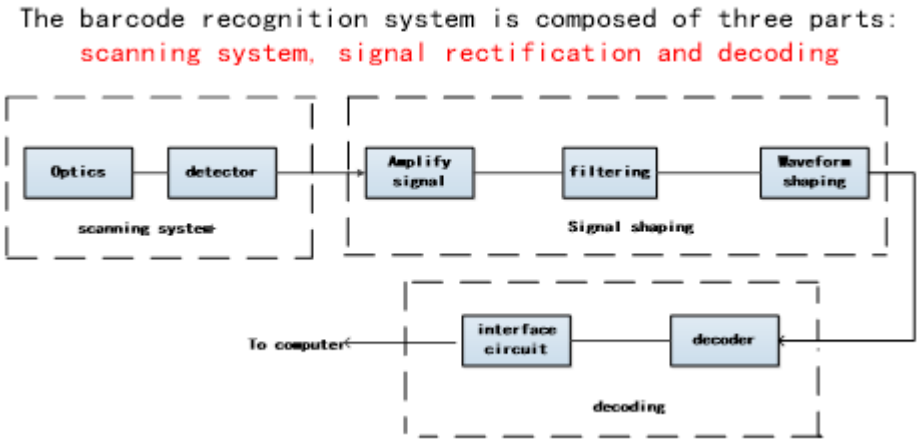

Figure 1: Composition of Barcode Recognition System

2. The research purpose of the project

As a process based machine vision image automatic recognition technology, the analysis of process status and control is currently the top priority that our team needs to study [1]. Firstly, Wang Wang et al. [2] proposed a dual half character recognition method for wheeled instruments based on convolutional neural networks. This method utilizes the learning characteristics of deep learning to extract deep features

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from wheeled instruments. Through practical research experiments, it was found that this method significantly improves the recognition accuracy of dual half characters; Secondly, Yang Guojia et al. [3] proposed a continuous casting slab end face information code recognition method based on support vector machine algorithm. After practical application, it was found that this method can fully achieve intelligent recognition of information barcodes, meeting the automation and energy needs of library borrowing books; Furthermore, Luo Hui [4] designed and implemented a machine vision based workpiece recognition and positioning system, which accurately identifies workpiece targets and determines their specific positions, providing reference for image recognition in other fields.

3. The role and position of the state and control of processes in the operating system

3.1. The role and location of process status in the operating system

A process is the dynamic execution process of a program, aimed at describing the dynamic characteristics of the process, enabling the system to correctly control the execution of the process. The process's lifecycle is divided into a group of states, and the activity process of the process is described using these states. The process's state and other information are recorded in the process control block.

The states of a process typically include the following.

Running status: The process is currently executing. For single core processors, only one process can be running at a time. On multi-core processors, multiple processes can be executed in parallel;

Ready state: The process is ready, but the processor has not yet been allocated. When a process is waiting to be assigned to a processor, it will be in a ready state;

Blocked state: The process cannot continue execution and needs to wait for certain external events to occur before continuing. For example, waiting for input/output completion, waiting for the release of a certain resource, and so on;

Create State (New): Indicates that the process is being created, meaning it is undergoing initialization operations;

Terminated state: Indicates that the process has completed execution or has been terminated.

These states control and manage the execution of processes in the operating system through scheduling algorithms. The process status may vary depending on different operating systems and specific implementations. In the process of designing the solution, this study applied it to the operating system. During the research and learning period, this article conducted in-depth research on the status and control of processes. This is because various process states may occur when the technology designed in this article is applied to machine equipment. The system needs to control the corresponding situations to enable the machine equipment to smoothly, quickly, and accurately complete the task of recognizing book barcodes. To make machine equipment more intelligent in completing tasks, this article not only requires an understanding of the status of various processes, but also provides corresponding solutions. This requires the use of process control. With in-depth research on process status and control, this article has improved various unexpected process related problems. The recognition process of barcode information is shown in Figure 2

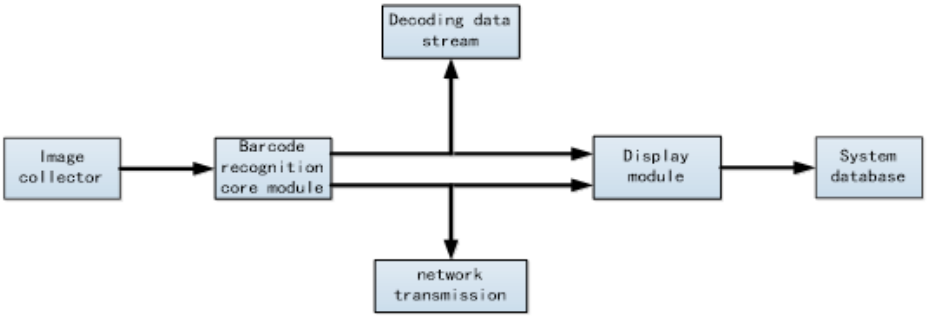

Figure 2: Recognition process of barcode information

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3.2. The role and position of process control in the operating system

In an operating system, process control is a crucial part of the system's execution and management of processes. Its function and position are reflected in the following five aspects.

Process creation and termination: The operating system is responsible for creating new processes and allocating necessary resources to them. Meanwhile, when a process completes its execution or encounters an exception, the operating system is responsible for terminating the process to free up resources.

Process scheduling: The operating system determines which processes can obtain processor time slices and run them through process scheduling algorithms. The scheduling algorithm aims to optimize processor utilization, response time, and throughput.

Process synchronization and communication: The operating system provides a mechanism for synchronization and communication between processes, ensuring correct interaction between multiple processes. This can include mutual exclusion between processes, synchronization primitives, and shared resource management between processes.

Process state management: The status documentation for the maintenance and management procedures of an operating system includes comprehensive details regarding the current state of processes, the information contained within the process control blocks, and the priority levels associated with these processes. These pieces of information can enable the operating system to manage and control processes more effectively.

Process resource management: The operating system records the resource information required by a process through the Process Control Block (PCB), including memory allocation, file descriptors, opened files, etc. The operating system is responsible for scheduling and allocating these resources, ensuring that resource contention and conflicts are resolved reasonably across multiple processes.

In summary, process control plays a crucial role in operating systems, responsible for managing and controlling the creation, execution, release, resource allocation, and scheduling of processes. This can ensure that multiple processes can run in coordination, effectively utilize system resources, and provide a good user experience.

Unlike today, the traditional book management model does not widely apply computer technology, and the entire process of library book borrowing activities relies on manual labor. This manual management method has many shortcomings, such as low borrowing process efficiency, poor processing ability, and limited users in the library[5] . The three-state model of the process is shown in Figure 3

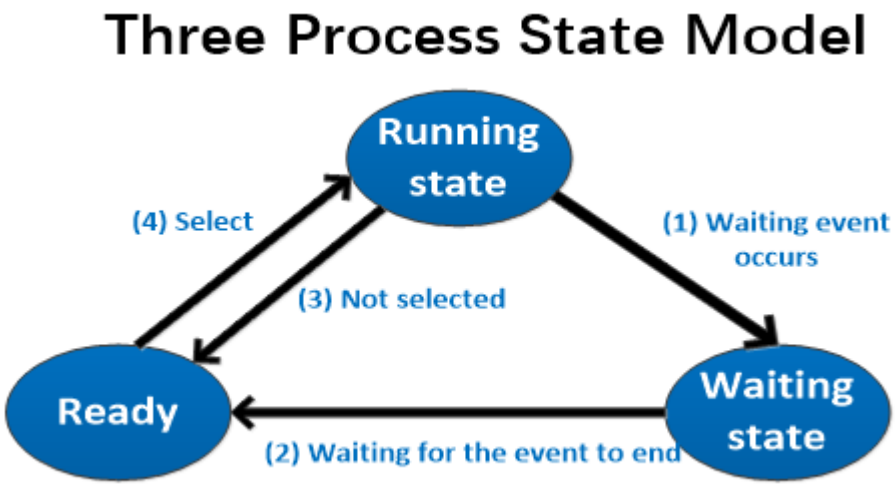

Figure 3: Three State Model of Process

4. The specific workflow of process status and control

In an operating system, the workflow of process status and control is usually as follows.

Process creation: When a user starts a program or the operating system needs to create a new process,

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the operating system assigns a unique process identifier (Process ID, PID) to create a new Process Control Block (PCB) and allocates necessary resources to the process. The process is initialized to a ready state.

Process scheduling: The running system selects the most suitable process from the prepared process queue based on the process scheduling algorithm, allocates control of the processor to the selected process, and enters the running state. The other processes remain in a ready state.

Process Execution: The selected process begins executing its instruction set. If there is a blocking event, such as waiting for input/output completion or waiting for resource release, the process will enter a blocking state and return processor control to the operating system.

Process blocking and wake-up: When a process encounters a situation where it is waiting for certain events to occur, it will request the operating system to switch it to a blocked state. At this point, the process will no longer occupy the processor and its state will be managed by the operating system. When a waiting event occurs, the operating system wakes up the corresponding process and changes its state.

Process termination: When a process completes all tasks or encounters abnormal situations, it enters a termination state. The operating system will recycle the resources occupied by processes and remove relevant process control blocks from the system.

Process switching: During process scheduling, when the operating system decides to switch processor control from one process to another, it saves the context information of the current process (such as register status) to the process control block, while restoring the context information of the next process.

References should be set to 10-point, justified, with single linespace and italic font style.

This workflow is continuously executed in a loop to manage and control multiple processes, ensuring the normal operation of the system. This continuous execution ensures that the system can respond to various needs and events in a timely manner, and effectively handle possible errors or abnormal situations, thereby improving the stability and reliability of the system. This cyclical management approach helps to achieve full utilization of system resources, while also being able to make corresponding adjustments as requirements change to meet the constantly changing workflow. The three-state transition process of a process is shown in Figure 4

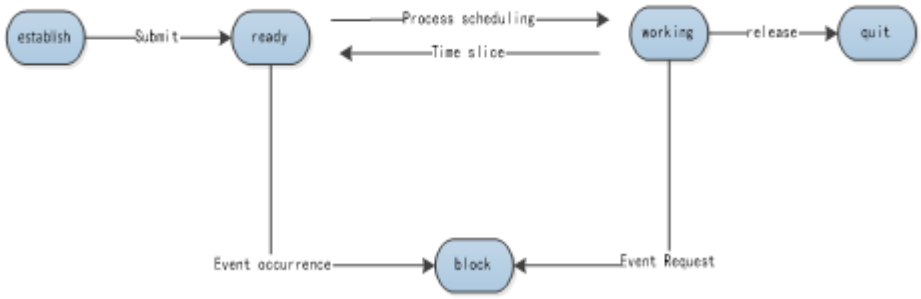

Figure 4: Three state transition diagram of the process

5. The status and control of the 4 processes, as well as the latest developments both domestically and internationally

5.1. Domestic development situation

At present, the status of processes in domestic operating systems and the development status of control technology industry can be elaborated from the following six aspects

Technical research: Major universities and research institutions in China have invested a lot of energy in the research of process status and control technology in operating systems, and have achieved a series of influential research results internationally. [6]

Industrial development: With the rapid development of technologies such as cloud computing, big data, and the Internet of Things, the domestic operating system industry has developed rapidly, forming competitive enterprises represented by Huawei, Alibaba, Tencent, and others.

Product application: Domestic operating system products have been widely used in key fields such

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as government, finance, telecommunications, and energy, and their market share has been increasing year by year.

Open source ecosystem: The open source ecosystem of domestic operating systems is gradually improving, and Linux based open source operating systems such as Kirin and Hongqi have been widely recognized and applied.

Technological innovation: Domestic operating system enterprises are constantly innovating in process status and control technology, such as Huawei's FusionSphere cloud operating system, which has independent intellectual property rights in process scheduling technology.

Policy support: The country has provided strong support to the operating system industry, and has introduced a series of policy measures to encourage and promote the development of the operating system industry, providing a good policy environment for process status and control technology research.

5.2. Development situation abroad

The status of foreign processes and the development status of control technology can be analyzed from multiple aspects.

Intelligent control technology: With the rapid progress and development of AI technology, intelligent control technology has received widespread attention and application. For example, robot control, autonomous driving technology, and smart home systems in the field of industrial automation. In these application scenarios, intelligent control technology can achieve functions such as autonomous decision-making, adaptive adjustment, and optimization, improving the intelligence level of the system.

Network control technology: With the popularization of Internet of Things technology, network control technology has been widely applied. For example, intelligent transportation systems, remote monitoring systems, and distributed power generation systems. In these application scenarios, networked control technology has been used to achieve data transmission and information sharing between devices, improving system integration and collaboration.

Micro control technology: With the advancement of microelectronics technology, micro control technology has been widely applied in various fields. For example, micro robots, micro drones, and embedded systems. In these application scenarios, miniaturization control technology has achieved the miniaturization and portability of equipment, and the flexibility and adaptability of the system have been improved.

Integrated control technology: With the continuous development of system integration technology, integrated control technology has been widely applied abroad. For example, smart factories, automated production lines, and large-scale infrastructure management systems in Industry 4.0. In these application scenarios, integrated control technology achieves integration and collaboration among multiple systems, improving system efficiency and reliability.

6. Shortcomings in Process Status and Control

Context switching overhead: In a multitasking environment, process switching requires saving and restoring context information of the process, which incurs certain overhead. As the number of tasks increases, the cost of context switching will gradually accumulate, affecting the overall performance of the system.

Blocking and wake-up mechanism: In traditional blocking and wake-up mechanisms, when waiting for an event to occur, the process is blocked until the event occurs before it is awakened. However, this mechanism has a low efficiency in handling large-scale concurrent and asynchronous tasks, which can easily lead to resource waste and reduced responsiveness.

Concurrency and synchronization control: In operating systems, concurrency and synchronization control mechanisms such as locks and semaphores can achieve coordination and exclusive access between multiple processes, but improper use can lead to issues such as deadlocks and starvation. Especially in complex multi-threaded or distributed environments, designing and debugging concurrency control mechanisms becomes more difficult.

Switching between kernel mode and user mode: In traditional operating systems, a process switching from user mode to kernel mode requires mode switching, which can cause significant overhead. Frequent

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kernel state switching can have a negative impact on system performance, especially in scenarios where a large number of short-term tasks are being processed. [7]

Scalability and Resilience: Some traditional process management and scheduling techniques find it difficult to meet highly dynamic and rapidly changing needs when facing large-scale distributed systems or cloud computing environments. Modern application scenarios require operating systems to quickly adapt to load changes and be able to flexibly schedule and manage process resources.

7. Improvement suggestions and development prospects for the status and control of 6 processes

The process status and control technology in operating systems are important components of computer system management, playing a crucial role in improving system resource utilization efficiency and ensuring stable system operation. Below, we will analyze the status and control technology principles of processes in the operating system, and propose specific improvement suggestions and development prospects.

7.1. Improvement suggestions

Optimization of scheduling strategies: More intelligent and dynamic scheduling strategies can be studied and developed for different system loads and process characteristics. For example, machine learning algorithms can be applied to process scheduling to achieve more dynamic and predictive resource allocation.

Process status monitoring and adaptive adjustment: The current process state control mostly relies on preset rules and thresholds. In the future, real-time monitoring of process status can be strengthened, combined with the current actual load and performance indicators of the system, to achieve more precise and adaptive process status adjustment.

Optimization of resource allocation: For multi-core processors and multi-core architectures, more efficient resource allocation algorithms can be studied and developed [8] to achieve optimal utilization of CPU and memory resources.

7.2. Development Outlook

Process management under cloud native and microservice architectures: With the popularity of cloud computing and microservice architectures, future process management will focus more on efficient scheduling and resource management in distributed environments.

AI based process management and optimization: The application of artificial intelligence technology will bring new opportunities for process management. For instance, it might be considered to apply machine learning algorithms to process scheduling in order to achieve a more dynamic and predictive resource allocation.

Process control for security and privacy protection: With the increasing awareness of network security and user privacy protection, future process control technologies need to better integrate security mechanisms to prevent the execution of malicious processes and data leakage.

Real time performance optimization: Future operating systems will focus more on the process of real-time performance optimization to meet application scenarios with high real-time requirements, such as autonomous driving, industrial control systems, etc. This requires research on new scheduling strategies and process control techniques to achieve faster response time and higher system stability.

Cross platform process management: With the popularity of multi platform devices such as smartphones, tablets, PCs, and servers, operating systems need to have cross platform process management capabilities to achieve seamless cross device resource scheduling and collaborative work.

Energy consumption optimization: With the demand for green computing and energy conservation and emission reduction, process control technology in operating systems will pay more attention to energy consumption optimization. This includes researching low-power process scheduling strategies and utilizing hardware and software technologies to reduce energy consumption during process execution.

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