Computer Fraud and Security
ISSN (online): 1873-7056

Analysis of Data Information Security in Higher Education Based on Computer Multimedia Technology

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Abstract:

In order to improve the effect of multimedia data analysis in higher education and solve the shortcomings in multimedia data processing and transmission, this paper improves the multimedia data scheduling algorithm and performs global scheduling. Moreover, this paper takes the task to be allocated from the global scheduling queue, selects the core according to a certain strategy, and assigns the task to the local queue of the kernel. Then, on each core, the original task scheduling strategy is executed to schedule the tasks that are ready in the local queue for execution. Moreover, this paper conducts an in-depth study on the application of parallel processing methods in multimedia processing and implements corresponding implementations. In addition, this paper explores the current development of multi-core technology and the use of multi-threaded parallel processing methods, and builds a program flow based on open source multimedia solutions. Finally, this paper takes the university education multimedia data analysis as an example to conduct experimental research. From the research results, we can see that the method proposed in this paper is quite effective.

Keywords: Higher education; multimedia; data analysis; computational solution; information security

1. INTRODUCTION

Multimedia is an indispensable tool for efficient teaching, and improving the effect of multimedia data processing plays an important role in improving the quality of teaching in colleges and universities.

The characteristics of multimedia data processing are many types of data and large amount of calculations, requiring the processor to have strong computing power and data bandwidth [1]. With the development of technology and the improvement of quality of life, people have higher and higher requirements for the multimedia processing performance of embedded devices. High-definition video can be seen everywhere, and supporting the recording and playback of high-definition video has become a basic function of embedded multimedia devices, but the serial processing method based on traditional single-core processors can no longer meet the performance requirements of embedded device multimedia processing. As a result, the parallel processing method of multimedia data processing based on multi-core processors has become a key to multimedia system design [2]. In order to meet the increasing requirements of multimedia processing performance, the traditional method is "vertical expansion", which simply improves the ability of the hardware device CPU to process data, that is, only increases the processing speed of a single-core CPU. However, this method will also produce other problems while increasing the processing speed, such as excessive heat generation and high price, which ultimately leads to low cost performance [3]. At present, multi-core technology is no longer unfamiliar in the PC industry or the embedded field [4].

With the rapid development of information technology, the performance of embedded systems is becoming more and more mature, and the scope of applications is becoming more and more extensive. With the expansion of application scenarios, people have higher and higher performance requirements for embedded systems. The development of the “heart” microprocessor and DSP and other special processors that are vital to the system has also become the focus of attention in the embedded field. However, the development of single-core processors has reached the limit due to the continuous increase in power consumption and the reduction in cost performance. With its outstanding features such as low power consumption and high performance, it has gradually replaced single-core processors as a new hardware platform in the embedded field. After several years of development, the application of multi-core technology in the embedded field has become a reality. Compared with the "vertical expansion" of single-core processors, multi-core processors use the "horizontal expansion" Ju 3 method to improve performance and be effective. Reduce power consumption. Multi-core technology enables the processor to perform more tasks in a specific clock cycle, so as to achieve the purpose of improving performance. Therefore, the development of multi-core technology in the embedded field provides a hardware foundation for the application of parallel processing in multimedia processing.

Embedded processors based on single-core architectures are becoming more and more difficult to meet the increasing performance requirements of embedded multimedia processing. Multi-core embedded architectures have become an effective way to solve this problem. At the same time, the development of multi-core technology is also about how to fully develop Corresponding software systems that take advantage of the multi-core structure bring challenges. Among them, parallel processing must be the top priority of software design, and the data stream itself in multimedia processing has inherent data processing parallel structure, so it is said that parallel processing methods in multimedia data processing The application in has great market application value, and the parallel processing method can be used to improve the efficiency of multimedia data processing.

This paper studies the relevant content of multimedia data analysis in colleges and universities, proposes multimedia data analysis solutions, improves the effect of multimedia data processing in colleges and universities, and improves the quality of college teaching.

2.RELATED WORK

In multimedia data processing, there is a certain correlation between most of the multimedia data, which provides a prerequisite for the application of parallel processing methods in multimedia processing. Therefore, the application of parallel processing methods in multimedia data processing has always been one of the research hotspots in the embedded field at home and abroad.

The literature [5] discussed the parallelism at the instruction level within a single processor. It utilizes DsP's instruction-level pipeline structure characteristics, uses pipelines for multimedia data parallel processing, and uses instruction-level parallel pipelines to optimize discrete cosine transform (DCT) algorithms and motion search algorithms in video processing. According to the structural characteristics of the instruction-level parallel 32-bit fixed-point processor, the literature [6] proposed some optimization methods suitable for parallel processing algorithms in the DCT, quantization and HumIlan coding parts of the JPEG algorithm to achieve the purpose of improving performance. Aiming at the characteristics of image data processing, based on a parallel distributed system with multiple instruction streams and multiple data streams, the literature [7] studied the parallelism of hotspot algorithms in image processing, and implements efficient parallel algorithms to optimize remote sensing image processing performance. The literature [8] proposed a task-level parallel processing method, which divides the processing of H-264 into multiple tasks and is executed on different processors on the platform C3400MDsP to realize task pipeline. The literature [9] designed two parallel algorithms for H-264 encoding based on the parallel processing model of Gpu to realize the parallel processing of part of the intra-frame prediction data. The literature [10] used a single instruction stream and multiple data streams to implement data parallel computing specifically for the transform coding part of H-264 encoding. Moreover, it changed the multiplication operation part of the transform coding into addition operation and shift operation, so as to achieve the purpose of improving efficiency.

Compared with deterministic data, uncertain data is not simply an additional probability dimension, but uncertainty has a great impact on the basic model, index, and query of the data. In the research on uncertain data query, literature [11] elaborated on uncertain data semantics, and divided the query on uncertain data set into 4 types: (1) Non-aggregated query based on value. For this type of query, the input is the object and its attributes, and the output is the value of the attribute; (2) Value-based aggregation query. The returned result is a single value, and the typical representatives are summation, average, and maximum and minimum query; (3) Object-based non-aggregated query. This type of query returns a group of objects that meet the individual query conditions; (4) Object-based aggregate query. This type of query returns a set of objects that meet the criteria of the clustering query. The literature [12] conducted an in-depth study on Top-k aggregation queries on uncertain data sets, and proposed the definitions and algorithm implementations of U-Topk and U-kRanks based on possible world models. The U-Topk query returns the k most likely top-k tuples among all possible world instances. U-kRanks returns k tuples, among which the i-th tuple has the highest probability of ranking in the i-th position among all possible world instances. The query result of U-kRanks is not necessarily the top-k in the possible world, and some tuples may appear multiple times. The literature [13] proposed the top-k query of the probability threshold of uncertain data. For a given threshold p, the PT-k query returns data whose probability of appearing in the top-k set in all possible world instances is greater than p.

The literature [14] proposed the Pk-Topk query algorithm. The algorithm returns the k data with the largest probability of belonging to the top-k set. The user only needs to specify the value of k, which is similar to the traditional database top-k query semantics and is more in line with user habits. The literature [15] proposed the nearest neighbor query on uncertain data sets. The PNN query returns data whose nearest neighbor probability is greater than p. Literature [16] proposed the nearest neighbor query p-KNN on a multi-dimensional uncertain data set. PNN query and p-KNN query have the same disadvantage: the user needs to specify the probability threshold p. The literature [17] proposed Top-k NN nearest neighbor query. The algorithm only requires the user to specify a threshold k, and returns the k pieces of data with the largest probability of being the nearest neighbor of the query point, which is more in line with user query habits. The above query processing algorithms for uncertain data sets have their own application areas, but they all have similar flaws: based on the assumption that there is a Score Function. For numerical uncertain data, this type of evaluation function is relatively simple, but uncertain multimedia data not only has many dimensional attributes. Moreover, many attributes are text information rather than numerical information, and it is difficult to design an evaluation function suitable for uncertain multimedia data and is not universal. In addition, the above algorithms have poor performance when processing high-dimensional data.

3.MULTIMEDIA DATA SCHEDULING MODE MODELING

Task scheduling in heterogeneous multi-core processor systems can generally be divided into two parts: first, global task scheduling, and second, local task scheduling. The two coordinate with each other to make the whole system run with higher efficiency. Global task scheduling means that the global scheduling strategy selects the task to be allocated from the global ready queue, and selects the appropriate processing core for the selected task according to a certain strategy, and then inserts the task into the local queue of the selected processing core in. This kind of scheduling can ensure the balanced use of the entire system resources. The local task scheduling refers to the task scheduling on each core, and the tasks in the local ready queue are scheduled and executed by executing the original scheduling strategy on the core.

In a multi-core processor system, task allocation and scheduling are divided into two steps: First, perform global scheduling, remove the tasks to be allocated from the global scheduling queue, select the core according to a certain strategy, and allocate the tasks to the local core of the core. In the queue; then, on each core, the original task scheduling strategy is executed to schedule the tasks that are ready in the local queue for execution.

The scheduling mode here uses the scheduling mode shown in Figure 1, which is derived from the above and can be divided into 4 modules. According to the order from left to right, it is the dispatch queue, the global scheduler, the distribution queue, and the local queues on each core[18].

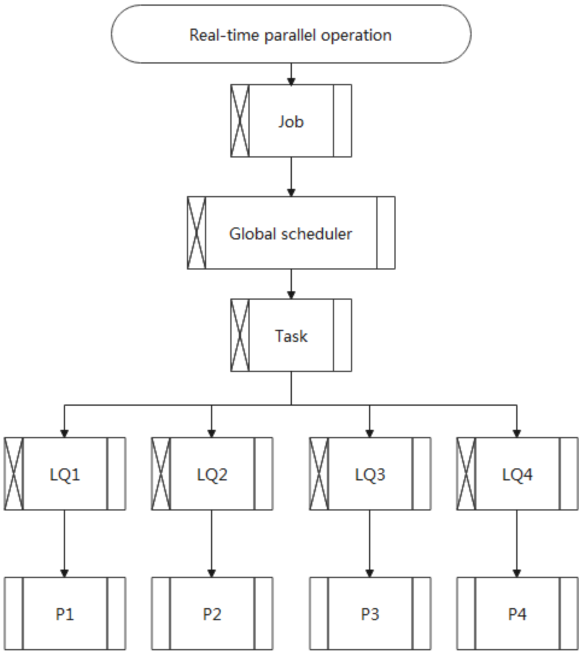


Figure 1 Schematic diagram of system scheduling mode

In the dynamic scheduling algorithm of heterogeneous multi-core processor systems, the global scheduler in Figure 1 will continuously adjust the allocation queue, and assign each task in the allocation queue to the appropriate cores according to a certain strategy. If all tasks can be allocated with suitable cores while satisfying the constraint requirements, the scheduling is successful; otherwise, it is unsuccessful. This article is mainly to study the feasibility of multimedia streaming computing task scheduling strategy in the system[19].

In order to apply the ant colony algorithm to the multimedia stream computing task scheduling in a heterogeneous multi-core processor system, the probability formula of task selection and the probability formula of processor selection are respectively given, and corresponding descriptions are given.

The probability formula and expectation formula for ant k to select the next task v_j are shown in formulas (1) and (2) respectively.

$$P_{i,j}^{k}(t)=\begin{cases}\dfrac{\tau_{i,j}^{\alpha}\cdot\eta_{i,j}^{\beta}(t)}{\sum\limits_{l\in allowedv_i}\tau_{i,j}^{\alpha}\cdot\eta_{i,j}^{\beta}(t)}, & if\ \ j\in allowedv_i\\ 0 & , otherwise\end{cases} \quad (1)$$

$$\eta_{i,j}(t)=\frac{1}{\log_2 DT_j\cdot\log_2 Data_j+1} \quad (2)$$

Among them, $\tau_{i,j}^{\alpha}$ represents the amount of information of the directed edges $e_{i,j}$ at time t, and allowedv$_i$ represents the set of tasks that task v can select in the next step. These tasks are in the unselected task set of ant k, and satisfy the in-degree is 0 or the in-degree is 1, and the weight is $|e_{i,j}|>0$. $\eta_{i,j}(t)$ represents the degree of expectation that ant k selects task Y in the next step. The design of this formula takes into account the deadline DT_j of task V_j and the estimated calculation amount $Data_j$ so as to ensure that tasks that are due earlier and tasks with a shorter execution time are executed first[20].

After ant k selects the next task V_j for task v_i, it also assigns a suitable processing core to task V_j so that the task can be executed on a higher-efficiency core. The probability formula and expectation formula of ant k assigning processing core p to task V_j are shown in formulas (3) and (4), respectively.

$$P_{i,j}^{k}\left(t\right)=\begin{cases}\dfrac{\tau_{j,l}^{\alpha}\cdot\eta_{j,l}^{\beta}\left(t\right)}{\sum\limits_{h\in allowedp_j}\tau_{j,h}^{\alpha}\cdot\eta_{j,h}^{\beta}\left(t\right)}, & if\ \ I\in allowedp_j\\ 0 & , otherwise\end{cases} \quad (3)$$

$$\eta_{j,l}\left(t\right)=\frac{sp_i}{\left(availtp_j\left(t\right)+1\right)\cdot\left(r_{j,l}+1\right)} \quad (4)$$

Allowedp$_i$(t) must be the set of all processing cores that satisfy the expression.

$$r_{i,j}=\max\left\{\max_{s\in pat_j}\left\{finish_s+\sigma_{s,j}\cdot\left|e_{s,j}\right|/w_{g,1}\right\},avail_l,AT_j\right\} \quad (5)$$

In formula (5), finish$_s$ represents the completion time of task v_s, $\sigma_{s,j}$ represents whether task v_s and task v_j are executed on the same processing core, 1 represents yes, and 0 represents no. $\left|e_{i,j}\right|$ represents the estimated communication volume between task v_s and task v_j, $w_{g,t}$ represents the communication bandwidth between the processing core P_g and the processing core p_i, and the task v_s is executed on the processing core P_g. Moreover, avail$_l$ represents the earliest available time of the processing core p_l, and AT_j represents the arrival time of the task v_j.

After the scheduling algorithm completes one iteration, the group m (size of the ant colony) group schedulable solution is obtained. At this time, the pheromone of the task-to-task path and the task-to-processing core path must be updated. According to the feasible solution, the pheromone on the path of the solution is adjusted. If it is assumed that the algorithm chooses the path from task v_i to task v_j, and then assigns p_i to task v_j, the pheromone update formula on the task selection path is shown in formulas (6), (7) and (8). Moreover, the pheromone update formulas on the processor selection path are shown in formula (9), formula (10) and formula (11)[21].

$$\tau_{i,j}\left(t+1\right)=\left(1-\rho\right)\cdot\tau_{i,j}\left(t\right)+\Delta\tau_{i,j}\left(t\right) \quad (6)$$

$$\Delta\tau_{i,j}\left(t\right)=\sum_{k=1}^{m}\Delta\tau_{i,j}^{k}\left(t\right) \quad (7)$$

$$\Delta\tau^{k}{}_{i,j}\left(t\right)=\begin{cases}Q/length_k, & \text{If ant k passes } e_{i,j} \text{ in this iteration}\\ 0, & \text{Otherwise}\end{cases} \quad (8)$$

$$\tau_{j,1}\left(t+1\right)=\left(1-\rho\right)\cdot\tau_{j,;}\left(t\right)+\Delta\tau_{j,l}\left(t\right) \quad (9)$$

$$\Delta\tau_{j,1}\left(t\right)=\sum_{k=1}^{m}\Delta\tau_{j,l}^{k}\left(t\right) \quad (10)$$

$$\Delta\tau^{k}{}_{j,l}\left(t\right)=\begin{cases}Q/length_k, & \text{If ant } v_j \text{ passes } p_l \text{ in this iteration}\\ 0, & \text{Otherwise}\end{cases} \quad (11)$$

Among them, ρ is the pheromone volatilization factor, which indicates how fast the pheromone decreases. The pheromone will gradually decrease over time, so that the continuous increase of pheromone can be avoided. The value range of ρ is (0.1). $\Delta\tau_{i,j}\left(t\right)$ represents the information increment on the path $e_{i,j}$ in this iteration, and $\Delta\tau_{i,j}\left(0\right)=0$, length$_k$ represents the task scheduling length obtained by ant k.

$\Delta\tau_{i,j}^{k}\left(t\right)$ represents the amount of information left by ant k on the path $e_{i,j}$ in this iteration.

According to different pheromone update methods, the ant colony algorithm model proposed by Dorigo.M can be divided into the following three types. The calculation formulas of $\Delta\tau_{i,j}^{k}(t)$ are shown in formula (12), formula (13), and formula (14) respectively.

1. In the Ant-Circle model (commonly used),

$$\Delta\tau^{k}_{i,j}(t)=\begin{cases}Q/length_k, \text{If ant k passes } e_{i,j} \text{ in this iteration}\\ 0, \quad Otherwise\end{cases} \tag{12}$$

2. In the Ant-Quantity model,

$$\Delta\tau^{k}_{i,j}(t)=\begin{cases}Q/d_{i,j}, \text{If ant k passes } e_{i,j} \text{ at time t and t+1}\\ 0, \quad Otherwise\end{cases} \tag{13}$$

3. In the Ant-Density model,

$$\Delta\tau^{k}_{i,j}(t)=\begin{cases}Q, \text{If ant k passes } e_{i,j} \text{ at time t and t+1}\\ 0, \quad Otherwise\end{cases} \tag{14}$$

In equations (12), (13) and (14), $length_k$ is the total length of the path traversed by ant k in this iteration, that is, the sum of the scheduling lengths of each segment of the path traversed by the ant. In the third model, the amount of pheromone spread by the ant on the path it travels has nothing to do with the length of the path it travels. Q represents the number of pheromone released by the ant in one iteration, and is generally taken as a constant. For the above three models, the main difference is that the latter two models use local path information, and the amount of remaining pheromone needs to be updated for each selection step. However, the first model uses the overall path selection information. In each iteration, the ants select a task and process the core before updating the amount of remaining pheromone. This way, on the one hand, the pheromone will not cause the frequently visited path to appear $\tau^{k}_{i,j}(t) \gg \eta_{i,j}(t)$ situations due to continuous accumulation, so that the expectation factor cannot play a role. On the other hand, it can also reduce the amount of information of the unselected path, and achieve better performance when solving the scheduling problem[22].

Compared with other models, the algorithm in the Ant-Circle model updates the pheromone after each iteration. In this way, the overall selection information is used, and the role of heuristic factors can be fully exerted, thereby achieving better performance. Therefore, this model is widely used in practice. The scheduling algorithm in this paper also uses this model to calculate $\Delta\tau^{k}_{i,j}(t)$.

For $\tau_{i,j}(t)$, because the ant colony algorithm is prone to fall into the local optimum prematurely, there will be a stagnation phenomenon. In order to improve this phenomenon, a strategy of limiting the amount of information on each path to $[\tau_{\min},\tau_{\max}]$ can be adopted. The values of $\tau_{\min}$ and $\tau_{\max}$ will be discussed in detail in the experimental part of the next chapter.

3.HIGHER EDUCATION MULTIMEDIA DATA ANALYSIS

There are many key technologies in wireless multimedia sensor networks, such as routing protocols, Qos assurance, topology control, data fusion technology, etc., all of which have very important research value and significance.

The wedge-shaped area in the two-dimensional spectrum corresponds to the direction component of the image, and a small-angle fan-shaped digital filter with a fan-shaped direction in any direction is also called the direction of the digital filter. A key issue of the filter bank direction (DFB) is how to divide the frequency into the required accuracy while maintaining the number of samples unchanged. This can be solved by image resampling and sector filtering. A simple directional filter bank is mainly composed of two modules: the first is a two-channel quincunx filter bank (Quincunx filter, as shown in Figure 2), where H0, H1, G0, G1 are directional filters, and the signal After X is filtered in the direction of H0 and H1, down-sampling and up-sampling are performed respectively, and the results obtained are filtered by G0 and G1, and the obtained results are added, and finally the stack is obtained. The quincunx filter bank usually divides the spectrum into two parts in the vertical and horizontal directions by a fan-shaped filter, and the black part represents the frequency domain part (as shown in Figure 3).

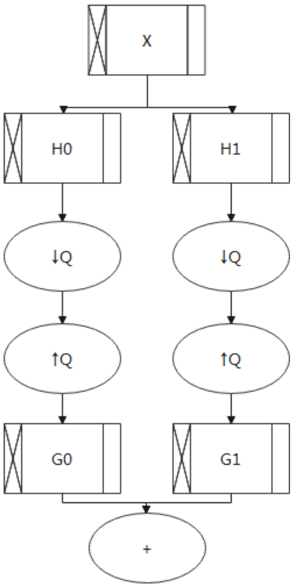


Figure 2 Quincunx filter

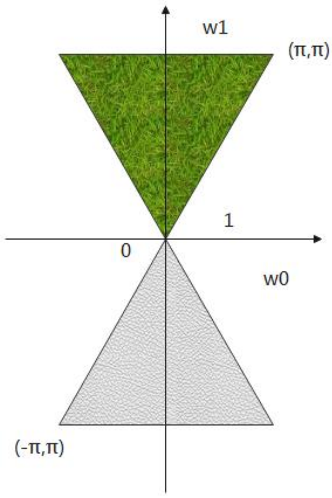


Figure 3 Sector filter

The first two stages use a directional filter bank for filtering (as shown in Figure 4), and the first stage uses a sector filter to decompose the signal into two directions, horizontal and vertical. The second stage uses a quadrant filter (as shown in Figure 5(a)). In this way, through two-stage filtering, four sub-bands of 0, 1, 2, and 3 can be obtained, as shown in Figure 5(b).

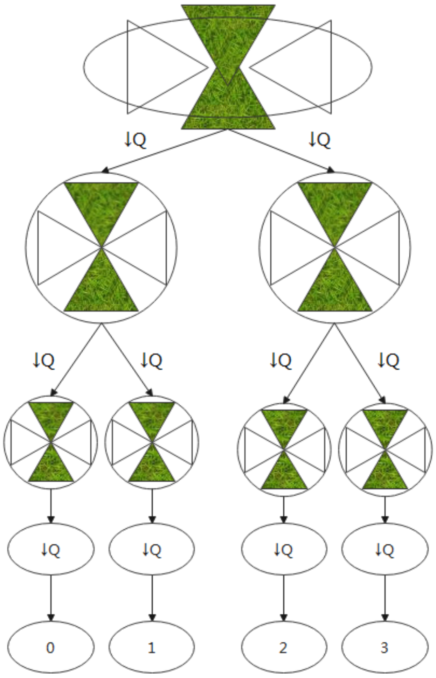
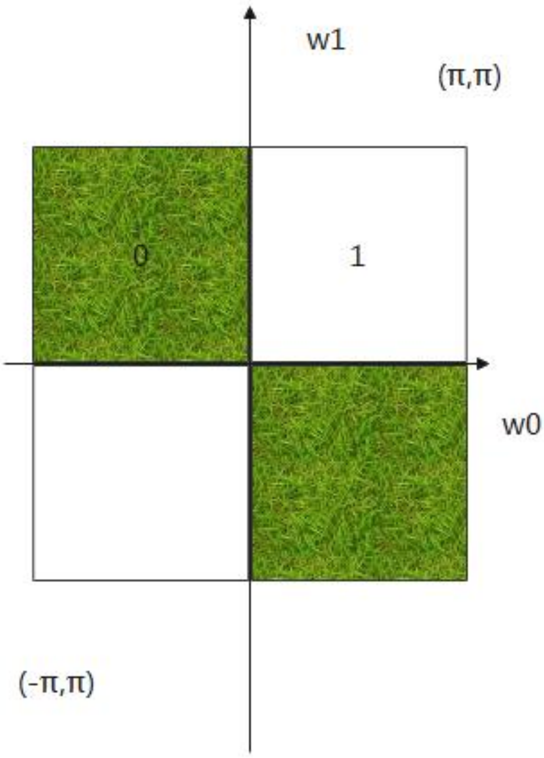
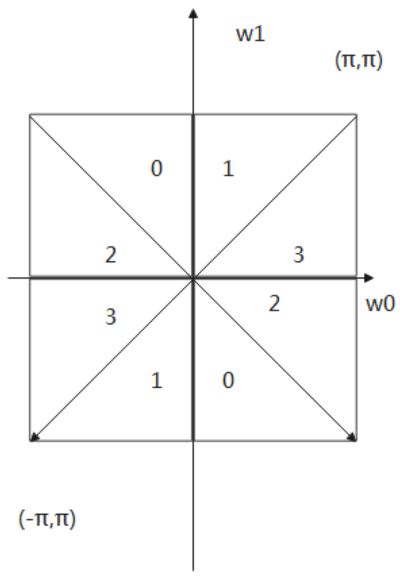


Figure 4 Decomposition of the first two stages of the directional filter



(a) Quadrant filter



(b) Directional subband

Figure 5 Directional decomposition

In order to obtain a finer frequency segmentation, this paper starts from the third stage to perform re-sampling first, and then perform directional filtering and down-sampling. The process is shown in Figure 6. The function of resampling is equivalent to a parallelogram filter and a sampling matrix, so the sampling matrix and the parallelogram filter can be used to iterate multiple times to obtain subbands in multiple directions. The structure of the entire f-stage directional filter bank can be used as shown in Figure 7. Since resampling only rearranges the sampled part, the inverse transformation of resampling during reconstruction can restore the original sequence. Therefore, the reversibility of the entire filtering will not be affected.

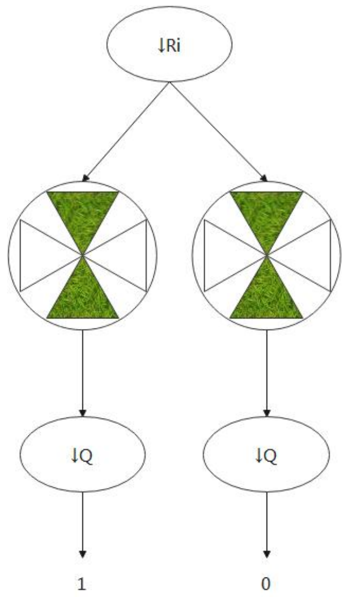


Figure 6 Third- stage decomposition of directional filter

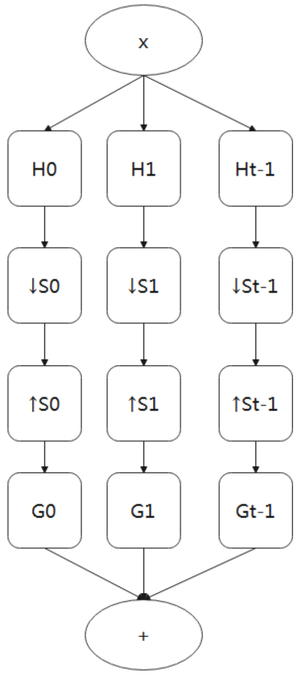


Figure 7 The structure of the entire l-stage directional filter bank

The two-dimensional fast wavelet transform of an image combines the filtering and sampling of the image, first performing row-direction filtering and row down-sampling, and then passing column-direction filtering and down-sampling. Among them, low-pass or high-pass filters can be used for filtering in the row and column directions. According to this method, M layers of multi-scale decomposition can be performed on the image, and 3M+1 layers of subbands with the same frequency can be obtained, including low-frequency components of 1 layer and high-frequency components of 3M layers. When the image is decomposed in one layer, 4 different frequency subbands, 1 low frequency component and 3 high frequency components (horizontal, vertical, diagonal) can be obtained. The image is decomposed in two layers as shown in Figure 8.

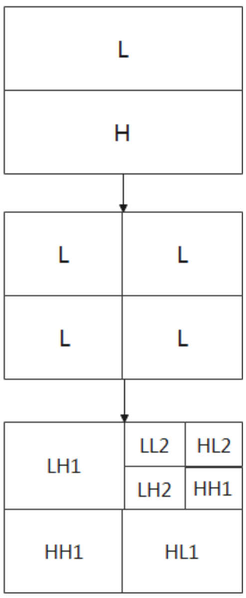


Figure 8 Two-layer decomposition process

The image fusion process based on wavelet transform is shown in Figure 9. A and B are two source images, and F is the fused image. The fusion process is as follows. (1) The source image is decomposed by wavelet transform to obtain the high and low frequency coefficients of the source image. (2) Different coefficients obtained after decomposition are fused with different fusion rules, and finally suitable high and low frequency coefficients are obtained. (3) The final fusion image is obtained by the inverse transformation of wavelet.

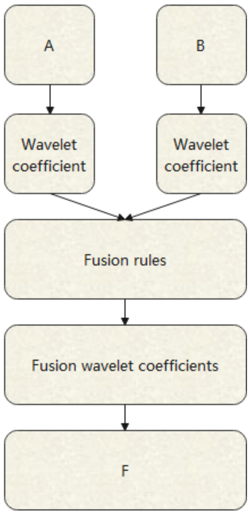


Figure 9 Image fusion process

The amount of multi-scale decomposition largely determines the computational complexity of the image fusion algorithm. In order to reduce the computational complexity of the algorithm, it can be considered from the aspect of reducing the decomposition scale, that is, simplifying the steps of wavelet decomposition. Figure 10 is a simplified two-layer decomposition process of wavelet decomposition.

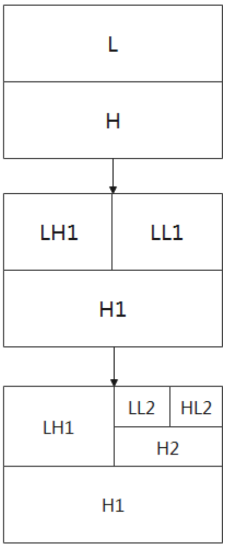


Figure 10 Improved wavelet decomposition process

Large amount of processed data is one of the characteristics of multimedia processing. In order to reduce the copying of data and improve the efficiency of multimedia processing, the multimedia processing framework designed in this paper adopts the mode of pre-allocating buffers. There is a pre-allocated buffer pool between each data processing unit. When the upper-level data processing unit wants to output data to the next-level unit, the upper-level unit first queries the free buffer in the buffer pool. After filling up the buffer, it will send the buffer to the next-level unit. After the next-level unit has processed the received buffer, it will release the buffer and send it back to the buffer pool. The specific process is shown in Figure 11:

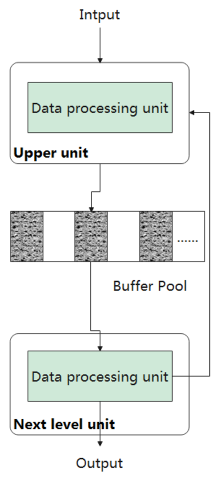


Figure 11 The transfer of buffers between data processing units

4.EXPERIMENTAL ANALYSIS OF HIGHER EDUCATION MULTIMEDIA DATA ANALYSIS SOLUTIONS

This paper designs an experiment to study the analysis of multimedia data in higher education, combining with the actual needs of multimedia data analysis in higher education to improve the algorithm. Moreover, this paper uses three different research objects of text, image, and video multimedia files to calculate the multimedia data processing effect and obtain multiple sets of data. The statistical results are shown in Table 1, and the corresponding statistical diagram is shown in Figure 12.

Table 1 Multimedia file processing effect

	Text	Image	Video
1	97.02	92.34	96.72
2	98.07	96.37	89.28
3	96.55	93.07	90.01
4	99.02	98.17	94.54
5	97.43	93.98	92.35
6	97.01	98.46	94.23
7	98.23	94.25	90.32
8	96.29	95.96	86.14
9	96.21	94.72	86.71

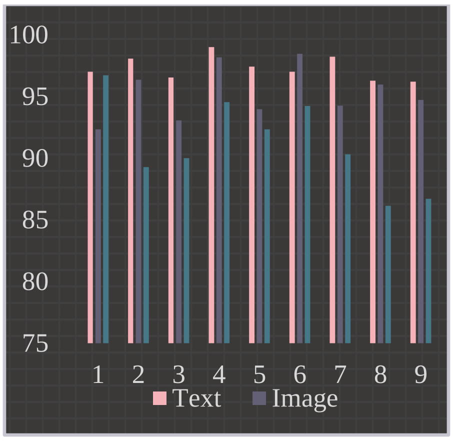


Figure 12 Calculation and processing of text, image, and video multimedia files

The research shows that the multimedia computing method proposed in this paper can effectively improve the processing methods of text, image, and video multimedia files. After that, the effect of multimedia teaching is improved, and the results obtained are shown in Figure 13.

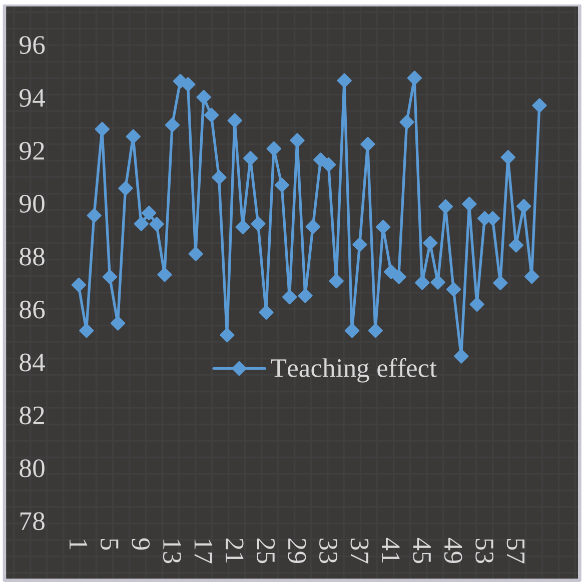


Figure 13 The teaching effect of the improved multimedia classroom

From the above research, it can be seen that the effect of multimedia teaching in higher education has been improved to a certain extent after multimedia data processing.

5.CONCLUSION

Computer science itself is an engineering discipline that systematically studies the theoretical basis of information and computing, and how they are implemented and applied in computer systems. How to implement and apply the latest theoretical research has always been one of the key issues in computer science. For video codecs with long-lasting vitality and fast-developing deep learning algorithms, it is a work of practical application value to combine the two more closely and friendly and give full play to the advantages of the two. In this thesis, the application of parallel processing methods in multimedia processing has been deeply researched and implemented accordingly. This paper introduces the current development of multi-core technology and the use of multi-threaded parallel processing methods. Moreover, based on open-source multimedia solutions, this paper proposes a general optimization method that uses parallel processing multi-threading technology to optimize video codec, and realizes multi-threaded decoders for videos such as H-264 and RV40. In addition, this paper takes the higher education multimedia data analysis as an example for experimental research. From the research, it can be seen that the method proposed in this paper is quite effective.

ACKNOWLEDGE:

Research on Modernization of Internal Governance System and Governance Capacity in Higher Vocational Colleges under the Background of the "Double High Plan" under the 14th Five Year Plan of Jiangsu Education Association（JS/2021/GH0207-07568）

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