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Title of Invention	PARALLEL PROCESSING APPARATUS AND ITS METHOD FORMULTIMEDIA DATA USING PIPELINE ARCHITECTURE ARRANGEDIN TIRES

### Abstract

1. The technical field in which the invention in claims belongs.

The invention relates to the computer recording the multimedia data parallel processing unit, using the stepped pipeline the method thereof and the program for materializing method. And it is about the recording medium which can read.

2. The technical problem which invention tries to solve.

The invention relates to a plurality of frames the successive multimedia data (example : streaming video). And there can be the purpose the recording medium can read is offered as the computer recording the multimedia data parallel processing unit, using the stepped pipeline parallelly parallelies the processing (example : encoding / decoding) by deviding and using the pipelining, and the method thereof and the program for materializing method.

3. The gist of the solution of invention.

The invention relates to the job control means multimedia data is input as to the multimedia data parallel processing unit from outside. And it transfers. Input and output control method for transferring to outside, the job control means it controls in order to partition multimedia data, and the job handling means of the job control means the respective multiple for transferring the frame of multimedia data is included from the job control means according to delivered. The job control means it controls in order to partition multimedia data is transmitted from input and output control method into a plurality of frames and it one by one assigns to a plurality of job handling means and it respectively parallelly works to the stepped pipeline architecture, and for transferring the process result among a plurality of job handling means from the specific job handling means according to delivered to input and output control method and repeatedly executing a process of assigning the frame which it makes by using in the corresponding job handling means. The job handling means of the job control means the respective multiple for transferring the frame of multimedia data is allocated the job control means is processed parallelly respectively by using the stepped pipeline architecture.

4. The important use of invention.

The invention is used to the multimedia data parallel processing unit etc.

### Representative drawing

Fig. 6

### Keyword(s)

The multimedia data, encoding / decoding, stepped pipeline, master-slave model.

### Description

#### ■ Background Art

The invention relates to the computerlegible medium recording the multimedia data parallel processing unit, using the stepped pipeline the method thereof and the program for materializing method. And more specifically, it is about the computerlegible medium recording the multimedia data parallel processing unit, using the stepped pipeline parallelly parallelies the processing (example : encoding / decoding) by the successive multimedia data (example : streaming video) being deviding into a plurality of frames and using the pipelining. The method thereof and the program for materializing method.

Recently, various services (real-time and non real time multimedia data service) for offering the multimedia data (example : video) as the electrical transmission of multimedia data more facilitates to the development of the high speed communications and personal computer are variously developed.

Particularly, the advantage the multimedia data service is required in case of the multimedia data streaming service and the download about multimedia data is started in comparison with the thing in which the problem that waited the long time until the multimedia data service of the existing download manner all downloaded high-capacity multimedia data had at the same time of immediately reproducing has. Here, in case of the streaming service, service possible through the network of the low bandwidth.

In the multimedia data streaming service as described above, high-capacity multimedia data has to be transmitted constantly with the computer of user. Therefore, the various kinds processing about the multimedia data, for example, encoding and decoding technique very important. Here, the multimedia data streaming service a lot can divide into the realtime streaming service (the example : intercast) and non real time streaming service (the example : video on demand streaming service). And the different property is required in being proceed processing (the example : encoding and decoding) about multimedia data according to the character of the target service. If encoding is in come for example and it explains, it very important to regularly keep the encoding time and resource use about multimedia data required in the angular step since the encoding about multimedia data, the electrical transmission, the capture (capture) etc. alternately has to operate in case of the realtime streaming service for the real-time guaranteed to each single step. On the other hand, in case of the non real time streaming service, it important to transmit on being required the multimedia data service from user after to the utmost in advance encoding multimedia data of many amounts within the minimum time.

In the meantime, among the various kinds of multimedia datas like the text, voice, image, the animation etc, if it particularly looks into about the most representative multimedia data moving picture than the figures 1 and 2, it today the same like next. Here, it decides to explain for the prior art about the basic building block of the general moving picture and moving picture encoding.

Figure 1 is one preferred embodiment illustrative view about the basic building block of the general moving picture.

Generally, the moving picture is included of a plurality of static images. One static images divides into the different detail unit. That is, one static images (picture) divides as shown in "11" into a plurality of macro blocks in which width, and the length of the length are the respective 16 pixel. And the static images divides into the as shown in "12" the combination generation of the macro block slice. At this time, one static images is included of the combination generation of slice. One static images is included in case of most of one slice. It is included in case of a part static images of a plurality of slices (13).

Here, the moving picture encoding technology it looks into about the technical principle of the encoding about the moving picture comprising by including the static images as described above a plurality of the time encoding technology of the mode storing only the part which overlapped with is signal-changed excluding the part is included compared to the space encoding technology, of the mode which eliminates the hard information it compartmentalizes it disappears it by the naked eye looked at it stored only the critical information of on-screen and the static images preceding. Particularly, in the time encoding technology, the frame accomplishing the moving picture can be classified according to the dependency whether or not (whether it can be independently encoded or not is not) of data into the key frame or delta-frame. Generally, one moving picture comprises a plurality of key frames, and that, more, the delta-frames of many numbers.

Here, the key frame (the key frame, in other words, the intra picture) with saying the frame storing only the signal-changed part after the key frame firstly the encoding (in other words, decoding), the dependent (the data dependence is gone) frame is said to other words, the encoding / decoding state which can be the encoding (in other words, decoding) of the key frame compared to the delta-frame (delta frame) is the key frame the frame which the frame storing all the information of on-screen is said is said. In the time encoding technology, a plurality of delta-frames which refers to the key frame after the specific key frame is the encoding (in other words, decoding) can become successively with the encoding (in other words, decoding). And delta-frame can be again subdivided according to the kind (the key frame or delta-frame) and number (the multiple reference) of the frame which oneself refers to the predictive coded picture (Predictive picture) and B picture (Bidirectional picture).

The encoding principles and the basic prior art about the moving picture as described above mentioned later decide to be into looked more particularly. Here, it today decides to explain in the side of the universally used time encoding technology.

Figure 2 is one preferred embodiment illustrative view about the moving picture encoding principles being general.

Here, as to 0 frame, 1 frame to 4 frame shows delta-frame. And delta-frames can be encoded among the key frame or the delta-frame preceding with reference to one or more frames.

The moving picture encoding is elementarily successively included as shown in fig. 2 according to data dependence. That is, by using the encoded 0 frame as described above after the encoding about the key frame 0 frame is completed, the encoding about 1 frame begins. After the encoding about 1 frame is completed, it is included of the mode in which the encoding about 2 frame begins. And the encoding about 4 frame begins after the encoding about 0 frame to the preceding frame 3 frame is completed. Here, when the multiple reference, after the encoding about the preceding frames is altogether completed in case of the frame in which in other words, the specific delta-frame precedes being to referred over one and being encoded, the encoding about delta-frame can begin. For example, in case of altogether referring to the delta-frame preceding with 0 frame in which delta-frame 2 frame is the frame of 2 a , in other words, the key frame 1 frame after the encoding for 1 frame and 0 frame is completed, the encoding about 2 frame can begin. As described above, the encoding about successively included each frame elementarily generates according to data dependence between each frame.

In the meantime, a plurality of static images accomplishing one moving picture or the various prior arts for a plurality of frames being processed parallelly in the different apparatus (example : main processor) and shortening encoding and decoding time about the full motion in order to be efficiently proceed encoding and decoding about the moving picture offered through the streaming service to user

comes out.

For example, in order to be processed as the key frame according to the multiple frame set auditory capsule combination generation beginning at the different main processor it can embody. In this case, the encoding / decoding independently can operate about combination generations since each combination generation beginning with the key frame. But there is a problem that in case of the prior art, it has to wait in the user (client) the long time until the numerous frames which accomplish the combination generation in the decoding about the moving picture at the user computer in order to be proceed the decoding about the specific combination generation of number are the message received altogether.

It can embody in order to be processed according to the kind (whether in other words, the key frame or not delta-frame) of the dissimilar frame at the different main processor. But there is a problem that the utilization ratio of the main processor which processes the key frame since the number of in this case, the key frame delta-frames extraordinarily manies very falls.

And in order to divide dissimilar one static images into a plurality of slices and it is processed at the different main processor it can embody. But there is a problem that in case of the prior art, the overhead according to each slice production together increases as the number of slice it is unable to divides increases the static images to a plurality of slices and the whole effectiveness falls. Moreover, there is a problem that the prior art uses in decoding only one main processor because the most of static imageses is included of one slice.

That is, there is a problem that the processing (example : encoding / decoding) technology about the conventional multimedia data as described above divides one multimedia data into a plurality of detail units and it processes parallel. In spite of that it waits of the user side due to the transit delay. The use efficiency decrease of the main processor etc. is caused. Accordingly, there is a problem that prior arts cannot offer the quick real-time / non real time streaming service to user.

## ■ Summary of Invention

### Effects of the Invention

Like above statement. And the present invention has the effect that successive multimedia data is divided into a plurality of frames and it parallelly processes in the different pipeline. In that way the processing (example : encoding / decoding) speed of multimedia data can be improved.

Moreover, the present invention has the effect that the processing about the later frame referring to the preceding frame begins in the situation in which the time difference is left and the different pipeline is proceed at a stretch and the processing about the preceding frame is not completed. In that way the processing about multimedia data can be proceed more efficiently.

Moreover, the present invention has the effect that the whole process step is divided based on the processing start time point and time of completion about each master frame into the single step by using the master-slave model and it keeps so that each single step turnaround time and requirement constant. In that way the real time multimedia data streaming service quicking than user is offered. The use of the main processor can be controlled effectively.

Moreover, the present invention has the effect that the number of pipeline for parallelly processing the multi- frames, and number of main processor it hardwares, for processing pipelines are constituted so that the determined ratio be. In that way the real time processing of the multimedia data service is guaranteed according to the determined ratio, or the processing (example : encoding / decoding) about multimedia data can be proceed efficiently than the time and resource use side.

Moreover, the present invention has the effect that it prevents that the target step is completed at the case where the fixed condition is fulfilled although it is completed that the processing (example : encoding / decoding) about the master frame dozes as to the master slave model and the processing about an plurality of slave frames at the same time processed with the master frame is so very much delayed to the next step. In that way it can keep so that each single step turnaround time and requirement constant. Therefore, it has the effect that the real time processing of the multimedia data service can be guaranteed more completely.

## ■ Brief explanation of the drawing

Figure 1 is one preferred embodiment illustrative view about the basic building block of the general moving picture

Figure 2 is one preferred embodiment illustrative view about the moving picture encoding principles being general

Figure 3 is one preferred embodiment illustrative view about the stepped pipeline according to the invention

Figure 4 is an example construct drawing about the multimedia data parallel processing unit using the stepped pipeline according to the invention

Figure 5 is one preferred embodiment illustrative view about the master-slave model according to the invention

Figure 6 is one preferred embodiment flowchart about the multimedia data method for parallel processing using the stepped pipeline according to the invention

Figure 7 is one preferred embodiment illustrative view about data dependence checking procedure at the multimedia data parallel processing unit according to the invention.

\* Description of the symbol of the main part of the drawing\*.

400: apparatus for processing multimedia data.

410: first work thread 411: first data dependence testing station.

412: first data processing block 420: second work thread.

421: second data dependence testing station 422: second data processing block.

430: third work thread 431: third data dependence testing station.

432: third data processing block 490: controller.

491: input/output control section 492: job control process.

#### ■ Technical Task

An object of the present invention to provide the computerlegible medium which is proposed in order to solve problem, and it parallelly parallelises the processing (example : encoding / decoding) by successive multimedia data being divided into the multi- frame and using the pipelining, and the processing about the later frame begins in the situation in which the time difference is left and the pipeline for processing the later frame according to the dependency about the preceding frame is proceed at a stretch and the processing about the preceding frame is not completed, and in that way records the multimedia data parallel processing unit, which more efficiently does for the sake of real-time / non real time multimedia data the processing (example : encoding / decoding) below using the stepped pipeline the method thereof and the program for materializing method.

Moreover, another object of the present invention is to the computerlegible medium recording the multimedia data parallel processing unit, using the stepped pipeline for controlling the resources use of the processing time main processor about real-time / non real time multimedia data the specific frame is selected successively according to each for each frame process sequence (the example : encoding or the order to be decoded) of multimedia data as the master frame by using and processes the master-slave model. The processing about a plurality of slave frames parallelly processed with the different pipeline is stopped as the processing about each master frame is completed and each processing level sort (processing is completed after the specific frame is selected as the master frame) turnaround time constants. In that way it guarantees the real time multimedia data service. The method thereof and the program for materializing method is offered.

Moreover, the invention relates to determined ratios (the example : one-for-one, and 1.5 large 1) the number of pipeline for being parallelly proceed the processings (the example : encoding or decoding) about a plurality of frames accomplishing multimedia data and number of main processor (CPU : Central Processing Unit) it hardwares, for processing pipelines. And another object is that the computerlegible medium recording the multimedia data parallel processing unit, using the stepped pipeline for minimizing the whole processing time to be required to the processing of non real time multimedia data constitutes. In that way the real time processing about the multimedia data service being guaranteed, or the method thereof and the program for materializing method is offered.

Moreover, the invention relates to the processing about a plurality of slave frames to the processing about the master frame be at its early stage completed as to the master-slave model and has to operate the substantial portion is the next processing level. And another object is that the computerlegible medium recording the multimedia data parallel processing unit, using the stepped pipeline for more completely guaranteeing the real time multimedia data service the corresponding processing level is closed in order to prevent to be delayed in case the fixed condition (the processing about the frame selected as the master frame of the next step operated among a plurality of slave frames over the substantial portion) is fulfilled although the processing about the master frame is completed. In that way the method thereof and the program for materializing method is offered.

Another object of the present invention and advantages can be understood with below description. And it clearly knows than the working example of the present invention. Moreover, the object of the present invention and advantages easily will be able to know to be newly materialized by the means and the combination shown for the patent claim.

#### ■ Structure & Operation of the Invention

Purpose is accomplished. And the apparatus of the present invention is equipped with the job handling means of the job control means: multimedia data is input from outside and it transfers as to the multimedia data parallel processing unit to the job control means, and it controls in order to partition input and output control method: multimedia data which it is transmitted from input and output control method from the job control means according to delivered into a plurality of frames and for transferring to outside the process result according to that is assigned one by one to a plurality of job handling means and it respectively parallelly works to the stepped pipeline architecture, and for transferring the process result among a plurality of job handling means from the specific job handling means according to delivered to input and output control method and repeatedly executing a process of assigning the frame which it makes by using in the corresponding job handling means. And job control means the respective multiple for transferring the frame of multimedia data which it is allocated the job control means is processed parallelly respectively the stepped pipeline architecture is used.

In the meantime, as to the multimedia data method for parallel processing, it includes the input stage, the frame formation step, the processing level, and the transfer stage transferring the process result about each frame to outside. The input stage is input multimedia data from outside. As to the frame formation step, the multimedia data which it is input as described above is partitioned and which is created a plurality of frames. The processing level parallelly processes the frame of the multiple which it is created as

described above by using a plurality of stepped pipelines.

In the meantime, the present invention is to provide the computer-legible medium recording the program for materializing the input function: framing function: processing function: of parallelly processing the frame of the multiple which it is created as described above by using a plurality of stepped pipelines and the pass-through function of transferring the process result about each frame to outside of the multimedia data which it is input as described above being partitioned and created a plurality of frames of being input multimedia data from outside in the multimedia data parallel processing unit equipped with the large scale processor.

The above-described purpose, and feature and advantage clear than the following detailed explanation related to the attached drawing. And a person skilled in the art easily will be able to enforce the technical mapping of the present invention in the technical field in which the invention belongs by that. Moreover, in describing the present invention, in case the concrete description about the notification technique related to the invention is determined the gist of the present invention because of gratuitously clouding, the detailed explanation decides to be omitted. The attached desirable working example according to the present invention decides to be explained hereinafter particularly.

Firstly, in the working example of less than about the invention, the most representative multimedia data moving picture is in come for example and it decides to explain. And in the streaming service of multimedia data, the encoding / decoding which it can because of being most core is in come for example among all kinds of the processing technologies about multimedia data and it decides to explain. That is, in the working example of less than, the multimedia data parallel processing unit according to the present invention explains case performing encoding and decoding about multimedia data as one working example. But it clearly lights that the invention is not thus limited.

Figure 3 is one preferred embodiment illustrative view about the stepped pipeline according to the invention.

Frames accomplishing the moving picture as shown in fig. 3 leave the time difference and it is parallelly processed at the different pipeline which at a stretch operates of the multiple (of for example, 4). At this time, in case of 1 frame, after the preceding frame 0 frame (key frame) is processed according to data dependence, it can be processed. But the processing about 1 frame has to begin after the processing about 0 frame is completed.

That is, by using the process result although the processing about 0 frame was not completed (only about 10% was for example processed), the processing about 1 frame can begin (of course, the processing about 1 frame cannot be completed before the processing about 0 frame is completed). That is, the processing about 0 frame operates in 0 pipeline. When the processing about 1 frame is parallelly included with this in 1 pipeline, the processing about 1 frame can begin as the processing about 0 frame is completed a part. The processing about the later frame 2 frame can begin in 2 pipeline as the processing about 1 frame is completed a part. And the processing about the later frame 3 frame can begin in 3 pipeline as the processing about 2 frame is completed a part. Moreover, as the processing about 0 frame is completed, the frame in 4 frame in which the sequence number most leads is divided in 0 pipeline among frames in which processing presently does not begin and processing can begin. At this time, the processing about 4 frame begins since the processing about the preceding frame of 4 frame 3 frame already began in the other pipeline, in other words, 3 pipeline.

In this way, in the invention, in the stepped pipeline, frames accomplishing the moving picture is parallelly processed at a plurality of pipelines. As the processing about the specific frame is completed in the task pipeline a part, in other words, the processing in which the processing about the later frame begins in pipeline about each frame leaves the time difference and it at a stretch begins and the parallel processing model of the mode which parallelly operates is said.

Here, it particularly decides to look into than the multimedia data parallel processing unit using the stepped pipeline as described above mentioned later. In the stepped pipeline, implementation possibles with many method. But it for example comes in and the case of embodying by here using the multiple thread (multi-thread) decides to be explained.

Figure 4 is an example construct drawing about the multimedia data parallel processing unit using the stepped pipeline according to the invention.

It decides data dependence whether or not of the respective frame which it is transmitted from the job control process (492) and in case data dependence has, it is proceed the processing about the corresponding frame according to the process result about the preceding frame. According to case data dependence has no, be immediately proceed the processing about the corresponding frame and complete the processing about the corresponding frame, it is transmitted the multimedia data (example : moving picture) from a plurality of work threads (410, 420, 430) for transferring to the job control process (492), and outside and it transfers to the job control process (492). It partitions the input/output control section (491) for transferring and multimedia data which it is transmitted from the input/output control section (491) according to delivered into outside and processed from the job control process (492) with work threads (410, 420, 430) it is created a plurality of frames. It controls so that it one by one by ones the frames which it is created as described above in a plurality of work threads (410, 420, 430) the allocation (dispersion) and the processing about each frame parallelly operate. According to delivered the process result about the corresponding frame from the task work thread (410), the job control process (492) for repeatedly executing the process of this being transferred to the input/output control section (491) and being delivered to outside and assigning the new frame to the task work thread (410) is included.

Here, each work thread (410, 420, 430) comprises data dependence testing stations (411, 421, 431) for transferring the process result about the preceding frame to data processing blocks (412, 422, 432) data dependence consequently and has data dependence whether or not of the frame which it is allocated from the job control process (492) is decided and data processing blocks (412, 422, 432) the corresponding frame is processed immediately according to delivered in case dependency has no and transferring the result about data dependence inspection from data dependence testing stations (411, 421, 431) to the job control process (492), and for transferring to the job control process (492) as the processing about the corresponding frame is proceed according to the process result of the preceding frame which it is together transmitted in case data dependence has and the processing about frame is completed.

And the job control process (492) is created a plurality of work threads (410, 420, 430) in order to embody the stepped pipeline according to the present invention. A plurality of frames in which multimedia data is partitioned and which it is created is assigned one by one to each work threads (410, 420, 430) which it is created as described above and work threads (410, 420, 430) are controlled so that a plurality of frames be parallelly processed. Here, according to each frames allocated to each work thread (410, 420, 430) is data dependence, the time difference begins to be left and it begins to be at a stretch processed with corresponding work threads (410, 420, 430).

That is, the job control process (492) takes charge of the overall control about each work thread (410, 420, 430) which parallelly acts. Simultaneously, multimedia data which it is transmitted from the input/output control section (491) is partitioned and a plurality of frames (the example : frame 0, frame 1, frame 2., the frame N-1 etc) is created. The frame which is created as described above is assigned one by one to each work thread (410, 420, 430) and it controls so that the frames of the multiple assigned as described above be parallelly processed. And the new frame is assigned from the task work thread (410) according to delivered to the work thread (410) and the process result of being transmitted as described above is transferred to the input/output control section (491) and the process delivered to outside is repeatedly. Here, work threads (410, 420, 430) can become the job control process (492) over one to a plurality of.

And according to the input/output control section (491) is delivered the multimedia data (example : moving picture) from outside, this is transferred to the job control process (492). This is outputted from the job control process (492) according to delivered to outside.

And a plurality of work threads (410, 420, 430) is parallelly respectively proceed the processing task about the practical frame, in other words, the encoding / decoding work about frame the job control process (492). That is, according to be one by one allocated frame from the job control process (492), data dependence testing stations (411, 421, 431) decide data dependence whether or not about the respective frame which it is allocated and the result is transferred to data processing blocks (412, 422, 432). In case data dependence has no, data processing blocks (412, 422, 432) immediately process the corresponding frame according to the result and it transfers to the job control process (492). The processing about the corresponding frame is proceed according to the process result about the preceding frame which it is transmitted from data dependence testing stations (411, 421, 431) in case data dependence has.

Here, it from time to time communicates with data dependence testing stations (411, 421, 431) and data processing blocks (412, 422, 432) decide the task go-stop about the corresponding frame. And until being transmitted the process result about the preceding frame from work threads (410, 420, 430) which process the preceding frame in case data dependence has in the corresponding frame, data dependence testing stations (411, 421, 431) provisionally discontinue task.

For example, in case of the frame 1, it is subordinate in the preceding frame in frame 0. Therefore, when the second data dependence testing station (421) of the second work thread (420) discontinues task until being transmitted the process result from the first data processing block (412) of the first work thread (410) processing the frame 0, this is transferred to the second data processing block (422) and the frame 1 the processing task (encoding or the decoding work) operates the process result according to delivered.

The multimedia data parallel processing unit using the stepped pipeline as described above has the effect that the processing about the multi- frame is proceed parallelly by using a plurality of pipelines. In that way the various kinds processing about the multimedia data, for example, the encoding / decoding can be proceed more efficiently.

In the meantime, in the working example of less than, the stepped pipeline is to the basis and it technicals, it or in other words particularly decides to look into for the real-time guaranteed of the realtime streaming service (example : intercast) for the efficient data processing (example : encoding / decoding) of the non real time streaming service (example : video on demand) in case of each in case of both sides than model.

Figure 5 is one preferred embodiment illustrative view about the master-slave model according to the invention.

Here, by using the master-slave model, multimedia data is encoded and it decides to explain in the side given one's service on user.

In order that the real time service of multimedia data is guaranteed, it together has to operate all kinds of the relateds operation including the electrical transmission of data, encoded besides the encoding process about multimedia data capture toward the image of the next turn etc. In the master-slave model is the different pipeline, the specific frame is selected of the frames of the respective processed multiple as the master frame. The encoding process about whole multimedia data is controlled to the mode (each pipeline is not closed) which the encoding about a plurality of slave frames in which encoding is not completed besides the master frame is delayd to the next encoding end system as the processing about the master frame is completed and terminates the corresponding encoding end system. In that way it operates between each encoding end system the other related operation including the electrical transmission, capture etc. Here, the processing about all slave frames begins if the processing about the master frame begins. And the processing about each slave frame is altogether stopped if the processing about the master frame is completed. Processing toward the rest of the slave frame in which processing is unable to be completed is delayed to the next encoding end system.

If the case of encoding multimedia data by using the pipeline of 4 from 0 pipeline to 3 pipeline is explained for example, as 0 frame is selected as the master frame, 1 frame to 3 frame parallelly encoded in besides frames in other words the different pipeline is framed the slave. Here, according to data dependence between frames, after the encoding about 0 frame begins, the time difference is left and 1 frame, 2 frame, and the encoding about 3 frame are at a stretch successively included.

In the first encoding end system, all slave frames in other words the encoding about 1 frame to 3 frame are provisionally stopped as the encoding about the master frame 0 frame is completed. The encoding about each slave frames is delayed to the next step. And the frame in 1 frame of 0 frame next order is selected as the master frame.

Thereafter, in the second encoding end system, all slave frames in other words the encoding about 2 frame to 4 frame are provisionally stopped as the encoding about the master frame 1 frame is completed. The encoding about each slave frames is delayed

to the next step. And the frame in 2 frame of 1 frame next order is selected as the master frame.

In this way, the specific frame is selected successively as the master frame. The start time point of the encoding about the slave frame and abort timing are decided according to the start time point of the encoding about the master frame and time of completion and each encoding end system is controlled. In that way the real time processing of multimedia data can be guaranteed. That is, by controlling the angular step of the encoding process it together operates the other service related operation except encoding and it on a real time basis answers to the demand of user.

The master-slave model as described above is identically applied to not only the realtime streaming service but also the non real time streaming service.

Figure 6 is one preferred embodiment flowchart about the multimedia data method for parallel processing using the stepped pipeline according to the invention.

Firstly, the input/output control section (491) is input multimedia data from outside (601). Here, multimedia data comprises real time streaming data and non real time streaming data.

Thereafter, according to the job control process (492) is delivered multimedia data from the input/output control section (491), multimedia data is partitioned and a plurality of frames is created (602).

And the job control process (492) is created a plurality of work threads (410, 420, 430) in order to parallelly process a plurality of frames. Here, the job control process (492) is proceed the initialization operation about each work thread (410, 420, 430).

And the job control process (492) one by one distributes a plurality of frames in each work thread (410, 420, 430) which it is created as described above (604). For example, in the first work thread (410), it can be proceed in the frame 0, and the second work thread (420) in the frame 1, and the third work thread (430) to the mode distributing the frame 2. Here, data dependence exists between each frame. Therefore, the frame 1 processing can begin according to the process result after the frame 0 processing begins. The frame 2 processing can begin after the frame 1 processing begins. That is, it can leave the time difference and the processing about each frame at a stretch can begin.

And the job control process (492) selects the master frame and the master thread processing the master frame (605). For example, the frame 0 can be selected as the master frame and the first work thread (410) can be selected respectively as the master thread. Here, the master thread says the corresponding thread allocated the processing about the master frame. And frame and corresponding thread of the besides multiple are threaded the respective slave frame and slave as the master frame and master thread are selected. That is, the frame 1, the frame 2 etc. are framed the slave. The second work thread (420), the third work thread (430) etc. are threaded the slave.

Thereafter, parallelly act and a plurality of work threads (410, 420, 430) processes the respective corresponding frame (606).

If this is into looked more particularly, it inspects data dependence and as data dependence does not exist, the first data dependence testing station (411) of the first work thread (410) allocated the key frame in frame 0 from the job control process (492) transfers the result to the first data processing block (412). It completes the frame 0 processing and the first data processing block (412) transfers as a result (encoding or the decoded frame) to the job control process (492).

Moreover, until inspecting data dependence and being transmitted the frame 0 the process result as the frame 0 data dependence exists, the second data dependence testing station (421) of the second work thread (420) allocated the delta frame in frame 1 from the job control process (492) for some time discontinues task. Here, the frame 0 the process result does not say the final product in which processing is completed. But the process result about one part of the frame 0 is said. Thereafter, according to the second data dependence testing station (421) is delivered the frame 0 the process result, this is transferred to the second data processing block (422). The second data processing block (422) starts the frame 1 processing by using the frame 0 the process result. And it transfers to the job control process (492) as the frame 1 processing is completed. Here, it from time to time communicates with the first data processing block (412) of the first work thread (410) and it is transmitted the frame 0 the process result and the second data dependence testing station (421) continuously transfers to the second data processing block (422).

Moreover, until inspecting data dependence and being transmitted the frame 1 the process result as the frame 1 data dependence exists, the third data dependence testing station (431) of the third work thread (430) allocated the delta frame in frame 2 from the job control process (492) for some time discontinues task. Thereafter, according to the third data dependence testing station (431) is delivered from the second data processing block (422) of the second work thread (420) the frame 1 the process result, this is transferred to the third data processing block (432). The third data processing block (432) starts the frame 2 processing by using the frame 1 the process result. And it transfers to the job control process (492) as the frame 2 processing is completed.

In this way, a plurality of work threads (410, 420, 430) parallelly acts and the corresponding frame is processed respectively. The beginning of the processing about each frame is successively included according to data dependence between frame. Each work thread (410, 420, 430) transfers to the job control process (492) according to complete the processing about the corresponding frame.

Thereafter, the job control process (492) decides whether or not the processing about the master frame was completed (607).

In case the decision result (607), and the processing about the master frame were not completed, each work thread (410, 420, 430) advances as the process (606) which parallelly acts and processes the respective corresponding frame. Processing toward the multiple slave frame of the master frame extrinsic is stopped in case the processing about the master frame was completed (608).

And the job control process (492) transfers the master frame processed completely from the master thread according to delivered to the input/output control section (491). The input/output control section (491) transfers the process result of being transmitted from the job control process (492) to outside (609). That is, this is transferred to outside according to complete the master frame in frame 0 processing.

And the job control process (492) decides whether or not the processing about whole multimedia data was completed (610).

It closes in case the decision result (610), and the processing about whole multimedia data were completed. In case the processing about whole multimedia data was not completed, it advances as the process (605) selecting the master frame and master thread.

If this is into looked more particularly, the job control process (492) successively selects each frame as the master frame. That is, the job control process (492) selects the frame 1 as the master frame as the frame 0 processing is completed. The corresponding thread of the frame 1 second work thread (420) is selected as the master thread. Here, in the first work thread (410) processing the frame 0, the frame (in other words, the frame N-1) of the next order is afresh allocated.

In the meantime, if frame referring to Figure 7 looks into the operation at data dependence testing station of each work thread in case of referring to one or more frames (the multiple reference), it thes same like next.

Figure 7 is one preferred embodiment illustrative view about data dependence checking procedure at the multimedia data parallel processing unit according to the invention.

The first work thread is not presently subordinate as shown in fig. 7 to the other work thread. That is, the first work thread can be proceed the processing about the corresponding frame even though it does not use the process result of the other work thread. On the other hand, the second work thread is subordinate in the first work thread. The third work thread is subordinate in the first and the second work thread. And the fourth work thread is subordinate in the first and the second work thread.

Here, in case of the third work thread and fourth work thread, if the process result about one or more frames which oneself refers to is transmitted respectively, then the processing about the corresponding frame can be started. For example, data dependence testing station of the fourth work thread from time to time communicates with data processing block of the first work thread and data processing block of the second work thread and the process result about each frame is transferred according to delivered to data processing block of the fourth work thread and the processing about the corresponding frame begins. Here, task is discontinued for some time in case of unable to being respectively transmitted the process result about the preceding frame referred to.

In the working example as described above, it for example came in and the case of embodying the stepped pipeline according to the present invention by using the multiple thread (multithread) was explained. But it hardwares, the realizable box in other words self-evidents this through the other method.

In the meantime, the method for maximizing the process efficiency of multimedia data in the non real time streaming service is exhibited in order to completely guarantee below, the realtime streaming service of multimedia data or.

Firstly, the number of in order to completely guarantee the realtime streaming service of multimedia data, each pipeline and main processor in the master-slave models is something corresponded to something made on a one-to-one basis and it has to guarantee so that the processing about the master frame immediately operate. That is, in the master-slave model, beginning and termination of each encoding end system pitch according to the start time point of the processing about the master frame and time of completion. Therefore, one main processor is occupied always and the processing about the master frame operates. In that way it importants that the processing about the master frame is not delayed.

Moreover, in order that the realtime streaming service of multimedia data is guaranteed, it importants to prevent from the processing about the master frame being so quickly completed and the processing about parallely processed a plurality of slave frames being so very much delayed to the next encoding end system. For this, although the processing about the master frame was completed, in case of being advanced over the substantial portion the processing about the slave frame in which the master frame is closes the corresponding encoding end system in the next encoding end system. But it can be exhaustive to grasp the processing status of the master frame at the next step at each encoding end system slave frame. Therefore, only in case the criteria type is fulfilled although the criteria type is established based on for convenience first slave frame and the processing about the master frame is completed in the specific encoding end system, the corresponding encoding end system is closed. The criteria type is as follows.

$$x = a * (b - 1) / b$$

(x: the total macro block number processed completely in the first slave frame a: the total macro block number of the first slave frame b: the number of total main processors)

In the meantime, in the non real time streaming service, in order that the processing (example : encoding / decoding) efficiency of multimedia data is maximized, the number of main processor it hardwares, for processing pipelines is littled more and the total duration to be required to the processing of multimedia data is minimized than the number of pipeline for parallely processings. For example, "1 the rate of pipeline and main processor 5: 1 "in other words" 2: it can constitute with 1"(here, with statistically most referring to the efficient rate rate can be any time changed). That is, preferable that the thing which it transmits on being required the multimedia data service to the realtime streaming service in which image is captured on a real time basis and which has to be proceed the encoding about that and which transmit the encoded data as described above with the user computer from user after to the utmost in advance encoding multimedia data of many amounts in case of the non real time streaming service within the minimum time it manies than the number of main processors and the multiple pipeline at the same time operates the number of pipeline it importantses in one main processor.

In the working example described in the above, the moving picture it was representative among multimedia data, was in come for example and it explained. But the parallel processing apparatus and the method thereof using the stepped pipeline according to the present invention can be applied without exception to the various kinds of multimedia datas including the voice, the animation etc., it self-evidents.

Moreover, in the working example, it self-evidents to for example come in the encoding / decoding but the invention is applied to the besides other multimedia data processing technology, also possible.

It embodies as the program and the method of the invention as described above can be saved as the computer legible form in the recording medium (the cdrom, RAM, ROM, floppy disk, hard disk, the magneto optical disc etc). In the technical field in which in this process, the invention belongs, it any more particularly explain since a person skilled in the art easily can enforce.

In the above, in the technical field in which the invention belongs, it is not limited with the working example which states before since possibling in the range that does not do not depart from the technical mapping of the invention having to a person skilled in the art many substitution, and the deformation and change and the attached drawing.

## Scope of Claims

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### ■ Claim 1:

The multimedia data parallel processing unit in which multimedia data is input from outside and transferring as to the multimedia data parallel processing unit to the job control means, and using the stepped pipeline including input and output control method for transferring to outside, the job control means it controls in order to partition multimedia data, and the job handling means of the job control means the respective multiple for transferring the frame of multimedia data from the job control means according to delivered. The job control means it controls in order to partition multimedia data is transmitted from input and output control method into a plurality of frames and it one by one assigns to a plurality of job handling means and it respectively parallelly works to the stepped pipeline architecture, and for transferring the process result among a plurality of job handling means from the specific job handling means according to delivered to input and output control method and repeatedly executing a process of assigning the frame which it makes by using in the corresponding job handling means. The job handling means of the job control means the respective multiple for transferring the frame of multimedia data is allocated the job control means is processed parallelly respectively by using the stepped pipeline architecture.

### ■ Claim 2:

The multimedia data parallel processing unit using the stepped pipeline, wherein the job control means as to the first claim in a plurality of job handling means, the specific frame is selected as the master frame and the frames of the besides multiple are selected of parallelly processed frames as the slave frame and the processing about the slave frame is stopped en-bloc as the processing about the master frame is completed and the corresponding processing level is closed and the processing about the slave frame is delayed to the next processing level and beginning and termination of each processing level are controlled.

### ■ Claim 3:

The multimedia data parallel processing unit using the stepped pipeline, wherein the job control means as to claim 2 the corresponding processing level is closed in case the fixed condition is fulfilled although the processing about the master frame is completed.

### ■ Claim 4:

The multimedia data parallel processing unit which the fixed condition uses the stepped pipeline characterizing the thing like the following (equation 1) as to claim 3.

(equation 1)

$$x = a * (b - 1) / b$$

(x: the total macro block number processed completely in the first slave frame a: the total macro block number of the first slave frame b: the number of total main processors)

### ■ Claim 5:

The multimedia data parallel processing unit using the stepped pipeline, wherein a process of selecting as the master frame the job control means is the specific frame as to claim 2 the corresponding frame is selected successively according to each process sequence of the frame in which multimedia data which is transmitted from input and output control method is partitioned and which it is created as the master frame.

**■ Claim 6:**

The multimedia data parallel processing unit using the stepped pipeline, wherein the stepped pipeline as to one claim, among the first claim to claim 5 it on a one-to-one basis each other corresponds to the main processor and it is matched.

**■ Claim 7:**

The multimedia data parallel processing unit using the stepped pipeline, wherein a plurality of job handling means as to one claim, among the first claim to claim 5 the respective frame which it is allocated is processed parallelly from the job control means by using the stepped pipeline architecture; and the process result about the reference frame is transmitted from time to time as data dependence exists and the processing about the corresponding frame is proceed and the processing about the corresponding frame is started in the situation in which the processing about the reference frame is not completed.

**■ Claim 8:**

The multimedia data parallel processing unit that uses the stepped pipeline, multimedia data parallel processing unit comprising: a plurality of data dependence verification means for transferring from the job control means to the corresponding data processing means it is from time to time transmitted from data processing means performing the processing about the reference frame the process result about the reference frame data dependence whether or not is inspected and data dependence exists about the respective frame which it is allocated and a plurality of data processing means for being from time to time proceed the processing about the corresponding frame from the corresponding data dependence verification means according to delivered.

**■ Claim 9:**

The multimedia data parallel processing unit using the stepped pipeline, wherein the stepped pipeline as to one claim, among the first claim to claim 5 it each other corresponds to the rate of the main processor and 1.5 large 1 and it is matched.

**■ Claim 10:**

The multimedia data parallel processing unit using the stepped pipeline, wherein the stepped pipeline as to one claim, among the first claim to claim 5 it each other corresponds to the rate of the main processor and 2 large 1 and it is matched.

**■ Claim 11:**

The multimedia data method for parallel processing using the stepped pipeline including the input stage, the frame formation step, the processing level, and the transfer stage transferring the process result about each frame to outside as to the multimedia data method for parallel processing. The input stage is input multimedia data from outside. As to the frame formation step, the multimedia data which it is input as described above is partitioned and which is created a plurality of frames. The processing level parallelly processes the frame of the multiple which it is created as described above by using a plurality of stepped pipelines.

**■ Claim 12:**

The multimedia data method for parallel processing using the stepped pipeline, wherein the processing level as to claim 11 in a plurality of pipelines, the specific frame is selected as the master frame and the frames of the besides multiple are selected of parallelly processed a plurality of frames as the slave frame and the processing about the slave frame is stopped en-bloc as the processing about the master frame is completed and the corresponding process step is closed and the processing about the slave frame is delay to the next process step and beginning and termination of each process step are controlled.

**■ Claim 13:**

The multimedia data method for parallel processing using the stepped pipeline, wherein the processing level as to claim 12 the corresponding process step is closed in case the fixed condition is fulfilled although the processing about the master frame is completed.

**■ Claim 14:**

The multimedia data method for parallel processing which the fixed condition uses the stepped pipeline characterizing the thing like the following (equation 1) as to claim 13.

(equation 1)

$$x = a * (b - 1) / b$$

(x: the total macro block number processed completely in the first slave frame a: the total macro block number of the first slave frame

b: the number of total main processors)

■ **Claim 15:**

The multimedia data method for parallel processing using the stepped pipeline, wherein a process of selecting as the master frame the specific frame in the processing level as to claim 12 the corresponding frame is selected successively according to each process sequence of the frame in which the multimedia data which it is input as described above is partitioned and which it is created as the master frame.

■ **Claim 16:**

The multimedia data method for parallel processing using the stepped pipeline of any one of claims 11 through 15, wherein the stepped pipeline it on a one-to-one basis each other corresponds to the main processor and it is matched.

■ **Claim 17:**

The multimedia data processing method using the stepped pipeline of any one of claims 11 through 15, wherein the processing level the frame allocated to each pipeline is processed parallelly; and the processing about the specific frame operates about the frame in which the specific frame is processed at the different pipeline according to data dependent fitness by from time to time using the process result about the reference frame and the processing about the specific frame begins in the situation in which the processing about the reference frame is not completed.

■ **Claim 18:**

The multimedia data processing method using the stepped pipeline of any one of claims 11 through 15, wherein the stepped pipeline it each other corresponds to the rate of the main processor and 1.5 large 1 and it is matched.

■ **Claim 19:**

The multimedia data processing method using the stepped pipeline of any one of claims 11 through 15, wherein the stepped pipeline it each other corresponds to the rate of the main processor and 2 large 1 and it is matched.

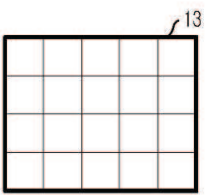
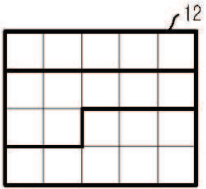
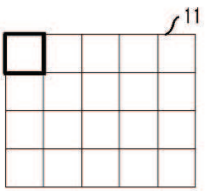
■ **Claim 20:**

The computerlegible medium recording the program for materializing the input function: framing function: processing function: of parallelly processing the frame of the multiple which it is created as described above by using a plurality of stepped pipelines and the pass-through function of transferring the process result about each frame to outside of the multimedia data which it is input as described above being partitioned and created a plurality of frames of being input multimedia data from outside in the multimedia data parallel processing unit equipped with the large scale processor.

## Drawing

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■ **Fig. 1**



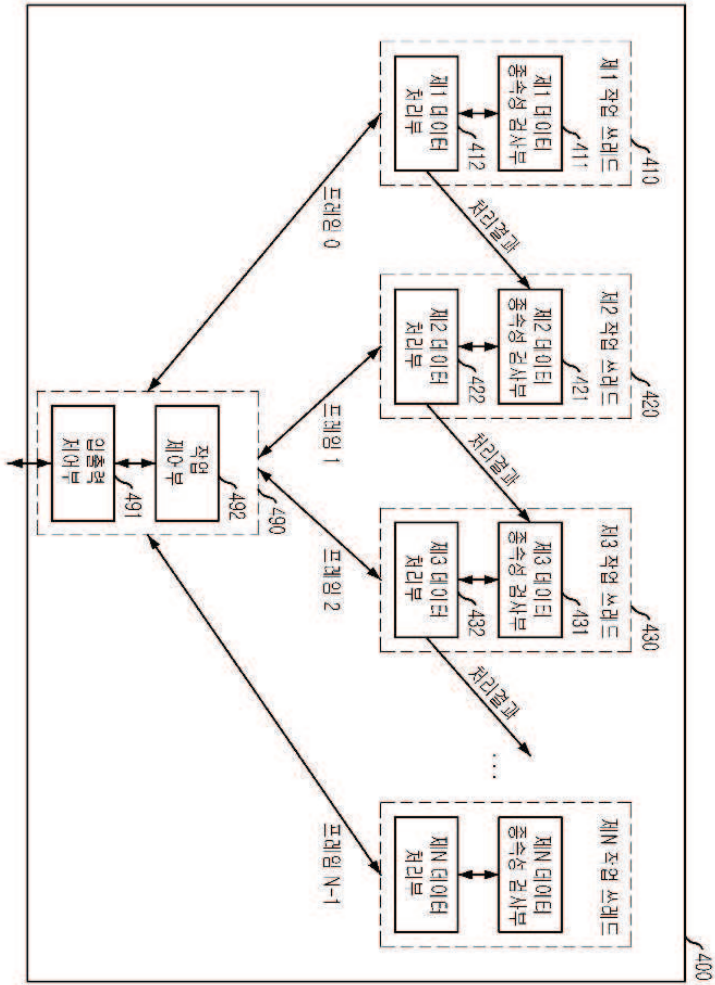
■ Fig. 2

0 프레임	1 프레임	2 프레임	3 프레임	4 프레임
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■ Fig. 3

0 파이프라인	0 프레임	4 프레임	8 프레임	12 프레임
1 파이프라인	1 프레임	5 프레임	9 프레임	13 프레임
2 파이프라인	2 프레임	6 프레임	10 프레임	14 프레임
3 파이프라인	3 프레임	7 프레임	11 프레임	15 프레임

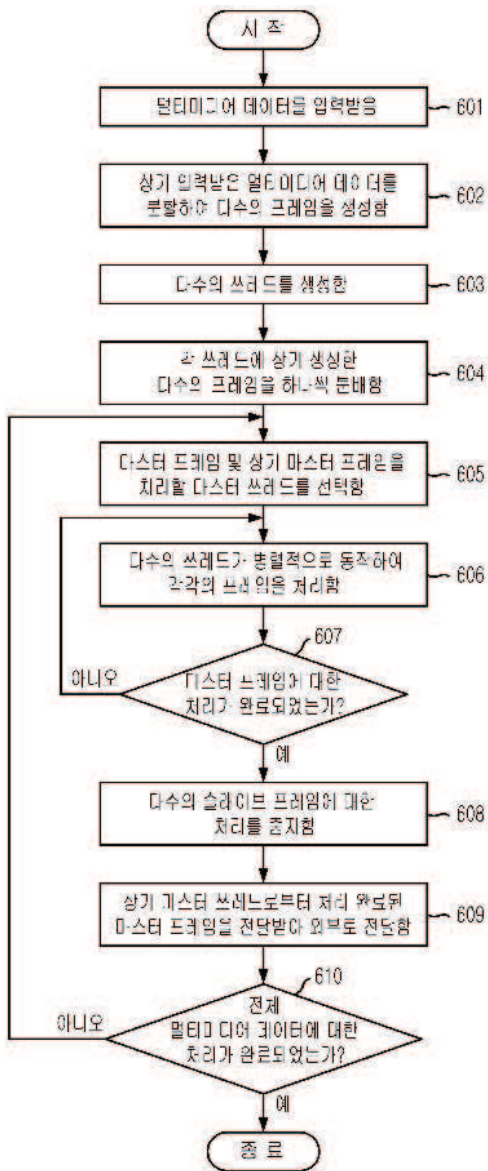
■ Fig. 4



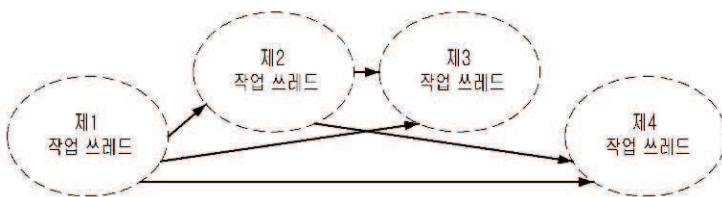
■ Fig. 5

0 프레임(마스터) 완료:100%	1 프레임(슬레이브) 완료:75%	2 프레임(슬레이브) 완료:45%	3 프레임(슬레이브) 완료:10%
4 프레임(슬레이브) 완료:15%	1 프레임(마스터) 완료:100%	2 프레임(슬레이브) 완료:80%	3 프레임(슬레이브) 완료:30%
4 프레임(슬레이브) 완료:40%	5 프레임(슬레이브) 완료:5%	2 프레임(마스터) 완료:100%	3 프레임(슬레이브) 완료:70%
4 프레임(슬레이브) 완료:80%	5 프레임(슬레이브) 완료:40%	6 프레임(슬레이브) 완료:15%	3 프레임(마스터) 완료:100%
4 프레임(마스터) 완료:100%	5 프레임(슬레이브) 완료:75%	6 프레임(슬레이브) 완료:40%	7 프레임(슬레이브) 완료:20%
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....

■ Fig. 6



■ Fig. 7



## Legal Status

Date	Type of Document	Status
2004.10.11	Patent Application	수리 (Acceptance)
2004.10.12	Submission of Attached Electronic Document	수리 (Acceptance)
2006.01.16	Request for Prior Art Search	수리 (Acceptance)
2006.02.20	Report of Prior Art Search	수리 (Acceptance)
2006.03.09	Notification of reason for refusal	발송처리완료 (Dispatched)
2006.03.10	Notification of change of applicant's information	수리 (Acceptance)
2006.05.08	Request for Extension of Designated Period	수리 (Acceptance)
2006.06.09	Amendment to Description, etc.	보정승인간주 (Regarded as an acceptance of amendment)
2006.06.09	Written Opinion	수리 (Acceptance)

2006.09.15	Decision to grant	발송처리완료 (Dispatched)
2008.01.10	Notification of change of applicant's information	수리 (Acceptance)
2009.10.23	Notification of change of applicant's information	수리 (Acceptance)

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