“CoaXPress,” the data transfer rate is standardized to 1.25 Gbps (effective transfer rate is about 1 Gbps) even when transferring the image data at the lowest rate. On the other hand, in the “GigE Vision” standard, the maximum data transfer rate is 1 Gbps (effective transfer rate is about 900 Mbps), so there is a problem in that when performing interface conversion of the image data from the “CoaXPress” to the “GigE Vision,” the communication band will lack. In particular, when the image data transmitted from a plurality of imaging devices are collectively transmitted to a single terminal device, the lack of communication band will be more significant.

[0009]

Embodiments of the present invention provide a multiplexer that can collectively convert image data acquired by a plurality of imaging devices adopting a certain data communication standard into another data communication standard and that can suppress the data transfer delay caused by the conversion. Embodiments of the present invention provide an imaging system including a plurality of such multiplexers and capable of suppressing the occurrence of differences in the imaging timing.

[Means for solving the Problems]

[0010]

According to a first aspect of the present invention, there is provided a multiplexer including: an input unit to which a plurality of image signals based on a first data communication standard are input, the image signals being acquired by respective imaging devices; an output unit that outputs an image signal based on a second data communication standard having a data transfer rate lower than that of the first data communication standard; a processing unit that converts the image signals based on the first data communication standard input to the input

unit into the image signal based on the second data communication standard; and a storage unit that temporarily buffers the image signals input from the input unit.

[0011]

According to the above aspect of the invention, in a system using a plurality of imaging devices adopting the first data communication standard, when converting into the second data communication standard having a data transfer rate lower than that of the first data communication standard, the image data from the plurality of imaging devices can be subjected to interface conversion with a single unit without preparing a unit for the conversion for each of the imaging devices. Moreover, even when the data transfer rate of the first data communication standard is higher than the data transfer rate of the second data communication standard, the input image data can be temporarily stored in the storage unit, and it is therefore possible to avoid the overflow due to the lack of bandwidth on the output side. Thus, since the image data acquired by the plurality of imaging devices adopting the first data communication standard can be collectively converted into the second data communication standard, the suppression of a delay in the data transfer due to the conversion is achieved.

[0012]

In an embodiment of the above aspect, the first data communication standard may be CoaXPress, and the second data communication standard may be GigE Vision.

[0013]

According to the above embodiment, the image data inputs from a plurality of imaging devices conforming to the “CoaXPress” standard can be received, and the data to be transmitted to a terminal device for image processing can be output in the “GigE Vision” standard; therefore, it is possible to construct an imaging system with a high

degree of freedom in the installation location of the imaging devices and a simple device configuration.

[0014]

In an embodiment of the above aspect, when each of the imaging devices is assumed to be an n-th imaging device (n=1 to m) and packet data input from the n-th imaging device (n=1 to m) to the input unit is n-th packet data (n=1 to m), the output unit may sequentially output an image signal based on the second data communication standard converted from first packet data input from a first imaging device to the input unit to an image signal based on the second data communication standard converted from m-th packet data input from an m-th imaging device to the input unit, and the n-th packet data (n=1 to m) may be data smaller than image data for one screen captured by the n-th imaging device (n=1 to m).

[0015]

In an embodiment of the above aspect, the n-th packet data (n=1 to m) may be image data for one pixel, a plurality of pixels, one line, or a plurality of lines that constitute one screen captured by the n-th imaging device (n=1 to m).

[0016]

When images are captured at the same time by a plurality of imaging devices, the image data is input at the same time to the input unit from respective imaging devices. If the image data is subjected to the interface conversion and output after the image data for one screen captured by each of the imaging devices is accumulated, then, as the number of images captured at the same time increases, the synchronicity of the captured images is lost and the transfer timing of the image data is delayed. According to the above embodiments, the image data can be sequentially output in a unit smaller than the image data for one screen captured by each of the imaging devices,

such as in a unit of packet data input to the input unit from each of the imaging devices, in a unit of one pixel constituting one screen captured by each of the imaging devices, in a unit of a plurality of pixels constituting the one screen, in a unit of one line constituting the one screen, or in a unit of a plurality of lines constituting the one screen, and the image data can thereby be subjected to the interface conversion and output without waiting that the image data for one screen captured by each of the imaging devices is accumulated; therefore, the image data can be transferred without losing the synchronicity of the captured images as much as possible, and the delay in the transfer timing of the image data can be suppressed.

[0017]

According to a second aspect of the present invention, there is provided an imaging system having a plurality of the above multiplexers, the plurality of imaging devices being connected to each of the multiplexers, the imaging system comprising a synchronization means that synchronizes respective times of the multiplexers.

[0018]

Depending on the data communication standard for image data, there are those, such as the “GigE Vision” standard, in which the delay time due to the transmission path is not ensured. In a system including a plurality of multiplexers and a plurality of imaging devices connected to each of the multiplexers, if the multiplexers and a terminal device for image processing are connected in accordance with such a data communication standard, when an attempt is made to perform simultaneous imaging with the plurality of imaging devices connected to each of the multiplexers, a difference will occur in the imaging timing by a difference in the delay time in each multiplexer system. According to the above embodiment, respective times of the plurality of multiplexers are synchronized by the synchronization means,

and the respective times of the plurality of imaging devices connected to each multiplexer are thereby also synchronized, and it is possible to achieve simultaneous imaging with these imaging devices without causing differences in the imaging timing.

[0019]

In an embodiment of the above aspect, the synchronization means may preferably synchronize the respective times of the multiplexers using a time synchronization protocol.

[0020]

According to the above embodiment, the time of the entire system can be synchronized by using the time of any one of the multiplexers and imaging devices constituting the system or the time of a terminal device connected to the system for image processing without separately providing inside the system a mechanism for transmitting a synchronization signal to the multiplexers.

[Advantageous Effect of the Invention]

[0021]

According to the multiplexer defined by the above embodiments of the present invention, it is possible to collectively convert the image data acquired by a plurality of imaging devices adopting a certain data communication standard into another data communication standard and suppress the data transfer delay caused by the conversion.

[Brief Description of Drawings]

[0022]

FIG. 1 is a schematic configuration diagram of an imaging system including a multiplexer according to an embodiment of the present invention.

FIG. 2 is a schematic configuration diagram of the multiplexer according to the embodiment.

FIG. 3 is a schematic diagram for describing the content of image data processing in the multiplexer.

FIG. 4 is a schematic configuration diagram of an imaging system including two multiplexers according to the embodiment.

[Embodiments for Carrying out the Invention]

[0023]

Hereinafter, one or more embodiments of the present invention will be described in detail with reference to the drawings. The embodiments described below are examples, and the present invention is not limited to these embodiments.

[0024]

FIG. 1 is a schematic configuration diagram of an imaging system 100 including a multiplexer 1 according to an embodiment of the present invention. The imaging system 100 is configured such that a plurality of imaging devices 2 are connected to an input unit 11 of the multiplexer 1 via cables. In the present embodiment, four imaging devices 2 (2a, 2b, 2c, and 2d) are connected to the