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(71) Applicant: SHAREVISION TECHNOLOGY, INC. [US/US]; 1901 McCarthy Boulevard, Milpitas, CA 95035 (US).

(72) Inventors: CHU, Frank, J.; 6388 Bancroft Way, San Jose, CA 95129 (US). YEH, C., Lung; 20100 Chateau Drive, Saratoga, CA 95070 (US).

(74) Agents: HSUE, James, S. et al.; Majestic, Parsons, Siebert & Hsue, Four Embarcadero Center, Suite 1450, San Francisco, CA 94111 (US).

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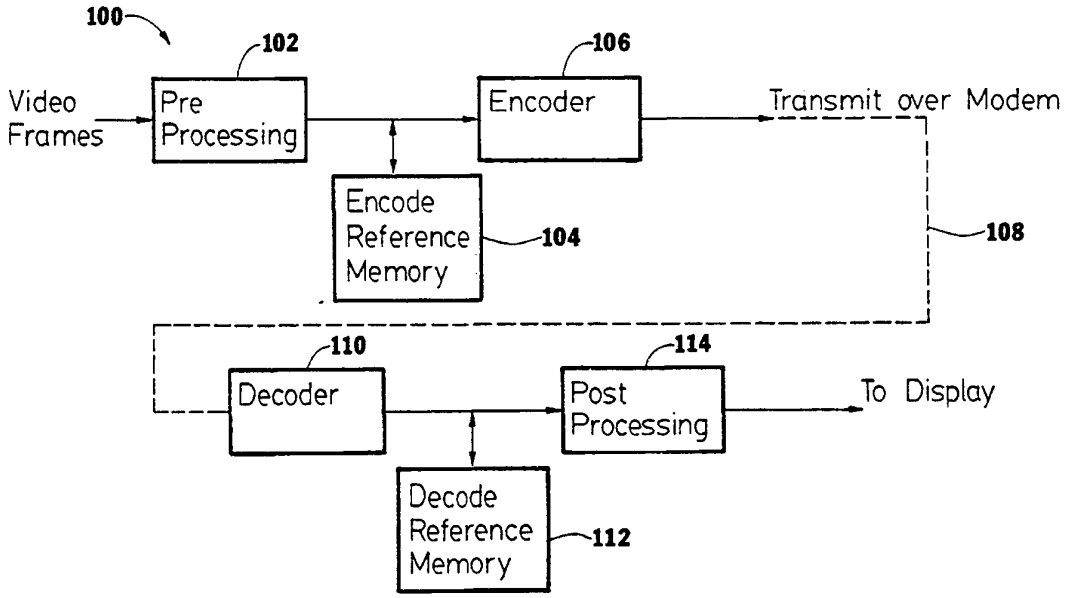

(57) Abstract

A video compression system comprises a pre-processing section (102), and encoder (106), and post-processing section (114). The pre-processing section (102) employs a median decimation filter (122) which combines median filtering and decimation process. The pre-processing section (102) also employs adaptive temporal filtering and content adaptive noise reduction filtering to provide images with proper smoothness and sharpness to match the encoder characteristics. The encoder (106) employs a two pass look-ahead allocation rate buffer control scheme where the numbers of bits allocated and subsequently generated for each block may differ. In the first pass, the means square error for each block is estimated to determine the number of bits assigned to each block in a frame. In the second pass, the degree of compression is controlled as a function of the total number of bits generated for all the preceding blocks and the sum of the bits allocated to such preceding blocks.

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DIGITAL VIDEO COMPRESSION SYSTEM UTILIZING VECTOR ADAPTIVE TRANSFORM

Background of the Invention

This invention relates in general to encoding and decoding of video information, and in particular, to a video compression system employing vector adaptive transform techniques that enables full-duplex transmission of video over ordinary analog telephone (POTS) lines.

Presently, commercially available modems readily allow a maximum of 14.4 Kbps (Kilobits per second) of data to be transmitted over a regular telephone (POTS) line. Existing video compression systems employed for encoding and transmitting video over digital channels (such as T1 or ISDN) require much higher bandwidth (i.e., 56 Kbps or higher). Therefore, conventional compression systems cannot be used for encoding and transmitting video over POTS lines. For this reason, dedicated and special channels must be used for existing video compression systems. The use of special and dedicated channels is expensive. It is therefore desirable to provide an improved video compression system for encoding and transmitting video

information which can transmit full-duplex full-motion color video information over ordinary telephone lines.

In the Related Application, a system and method for audio, video and data conferencing is proposed which enables audio, video and computer data to be transmitted over a POTS line. In such system, bandwidth allocation for each type of data is dynamically and adaptively dependent on the amount of data present, pre-assigned priority and predetermined bandwidth requirements. In the preferred embodiment of the Related Application, audio, computer and video data conferencing between interlinked computer systems favor assigning top priority to audio followed by computer and then video data. Concurrent audio, computer and video data conferencing can be communicated over a regular POTS link. The video compression system and method of this invention will work in the context of the concept of the Related Application for transmitting video data over a POTS line.

In many of the existing video compression systems, a fixed bandwidth is allocated to video information. One of the key concerns in such existing systems is to apply video compression so that the video information transmitted can fit within such fixed bandwidth. A spatial domain to transform domain transformation is first performed and the transform video information is stored in a rate buffer in such video compression system. In order to ensure that appropriate video compression is applied, such system employs rate buffer capacity control feedback to control the compression so that the data is transferred out from the rate buffer at a synchronous rate.

In the preferred embodiment of the Related Application, however, video information is assigned the lowest priority so that the bandwidth allocated to video information may vary from the entire bandwidth available

to none at all. Therefore, the above-described conventional video compression system cannot be used in the context of this system described in the Related Application. Therefore, it is desirable to provide an improved video compression system that can accommodate variable bandwidth allocated to video.

Summary of the Invention

As indicated above, in the preferred embodiment of the Related Application, audio information has the highest priority, computer data the second priority, and video information the last priority. Therefore, the transmission of video information can be stopped completely when necessary. Such system design calls for video compression which is different from the above-described conventional video compression scheme. The video compression system of this invention employs look-ahead bit allocation rate buffer control where the data is transferred out of the rate buffer at an asynchronous rate so that the numbers of bits allocated and subsequently generated for coding a block may be and are usually different from those for coding another block.

The video compression system of this invention comprises three sections. The first preprocessing section employs a median decimation filter which combines median filtering and a decimation process. An adaptive temporal filter and a content adaptive noise reduction filter are employed to provide images with proper smoothness and sharpness to match the coder/decoder ("codec") characteristics.

The second section employs a two pass look-ahead bit allocation rate buffer control scheme. Since the bandwidth available may differ from frame to frame, the video compression system of this application first checks the number of bits available for a particular frame, and allocates a number of bits to the encoding of

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