ABSTRACT

The present invention relates to a computer-implemented method, system and computer readable medium for determining illegitimate three dimensional videos. Methods are disclosed for efficient scene mapping process employed during the watermark extraction stage using non-blind watermarking methods, for example, singular value decomposition (SVD). Watermarks are embedded in a dual mode by treating the center video and depth video as separate channels of a three dimensional video.

REF FIG: 1

What is claimed is:

1. A computer-implemented method executed by one or more computing devices, the method comprising:

comparing each of a one or more scenes of a resembling video with each scene of an original video by calculating a difference between a first scene averaged frame of an original video and a second scene averaged frame of a resembling video;

identifying the one or more scenes of the resembling video as similar scenes in the event the difference is lesser of equivalent to a predetermined threshold value;

mapping each frame of the similar scenes of the resembling video with each frame of the original video wherein the match is determined by selecting the frame of the first scene of the first video for which the corresponding singular value score is minimum; and

selecting the corresponding frame of the original video with a minimum singular value difference as identical to the second frame of the identified scenes.

2. An automated system comprising:

an input terminal operative to receive a original video and a resembling video;

a processing sub-system having a processor and a memory, the memory capable of storing software components for execution by the processor, the software components comprising:

a scene comparator operative to compare each of a one or more scenes of the resembling video with each scene of the original video;

a scene identifier operative to identify the one or more scenes of the resembling video with a singular value difference score lesser or equivalent to a predetermined threshold value;

a frame comparator operative to map each frame of the similar scenes of the resembling video with each frame of the original video wherein the match is determined by selecting the frame of the first scene of the first video for which the corresponding singular value score is minimum; and a scene selector operative to select the corresponding frame of the original video with a minimum singular value difference as identical to the second frame of the identified scenes.

and

a graphical interface coupled with the processing sub-system and operative to display the one or more selected frames.

3. A computer readable medium having a set of instructions for execution on a computing device, the set of instructions comprising:

a scene comparator routine operative to compare each of a one or more scenes of the resembling video with each scene of the original video;

a scene identifier routine operative to identify the one or more scenes of the resembling video with a singular value difference score lesser or equivalent to a predetermined threshold value;

a frame comparator routine operative to map each frame of the similar scenes of the resembling video with each frame of the original video wherein the match is determined by selecting the frame of the first scene of the first video for which the corresponding singular value score is minimum; and

a scene selector routine operative to select the corresponding frame of the original video with a minimum singular value difference as identical to the second frame of the identified scenes.

Dated this 6th day of December, 2013

Ajay Kumar Sarkar
Infosys Limited
Patent Agent No 1652

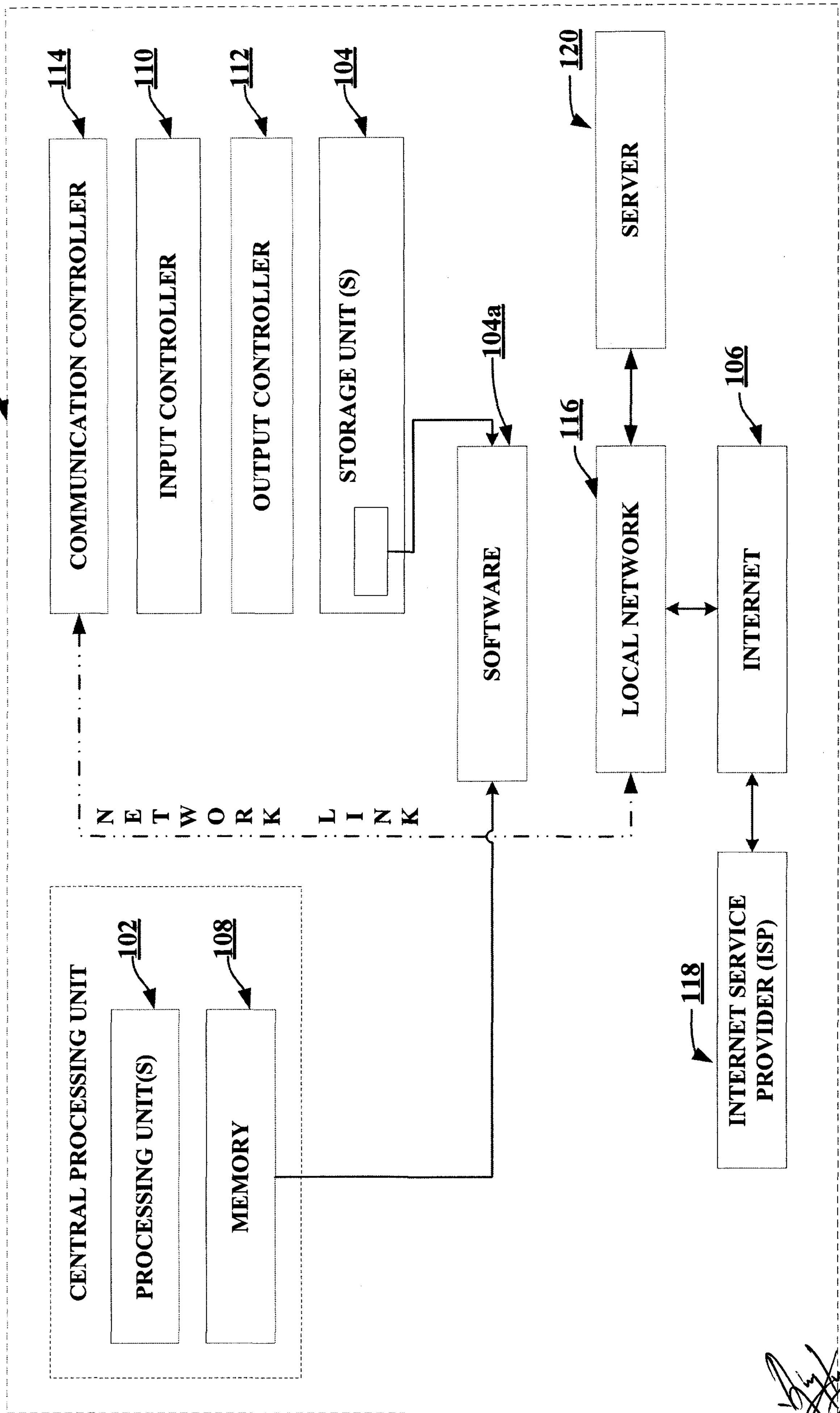

FIGURE 1
(PRIOR-ART)

Ajay Kumar Sarkar
Infosys Limited
Agent No. : 1652

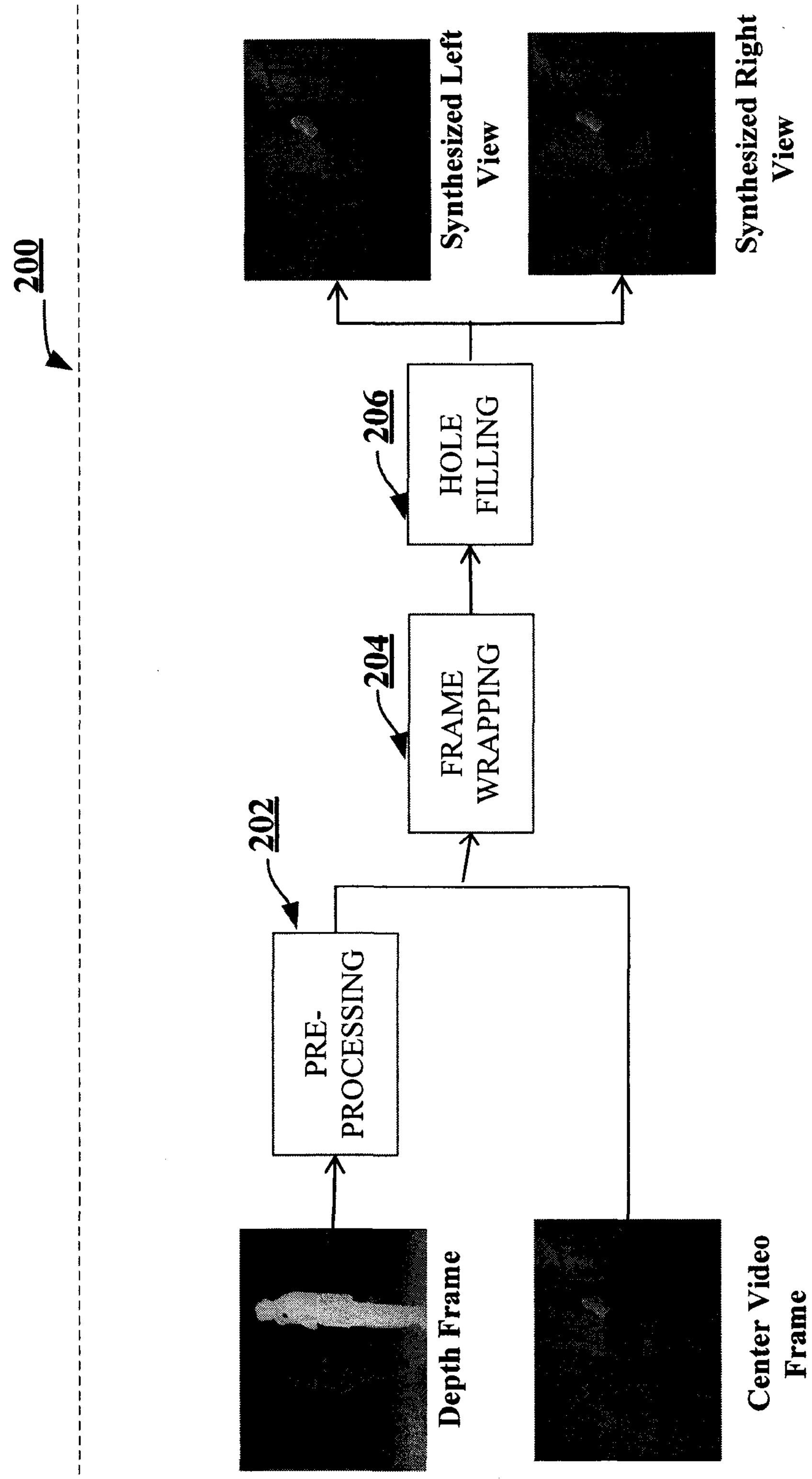

FIGURE 2 (PRIOR-ART)

Ajay Kumar Sarkar
Infosys Limited
Agent No. : 1652

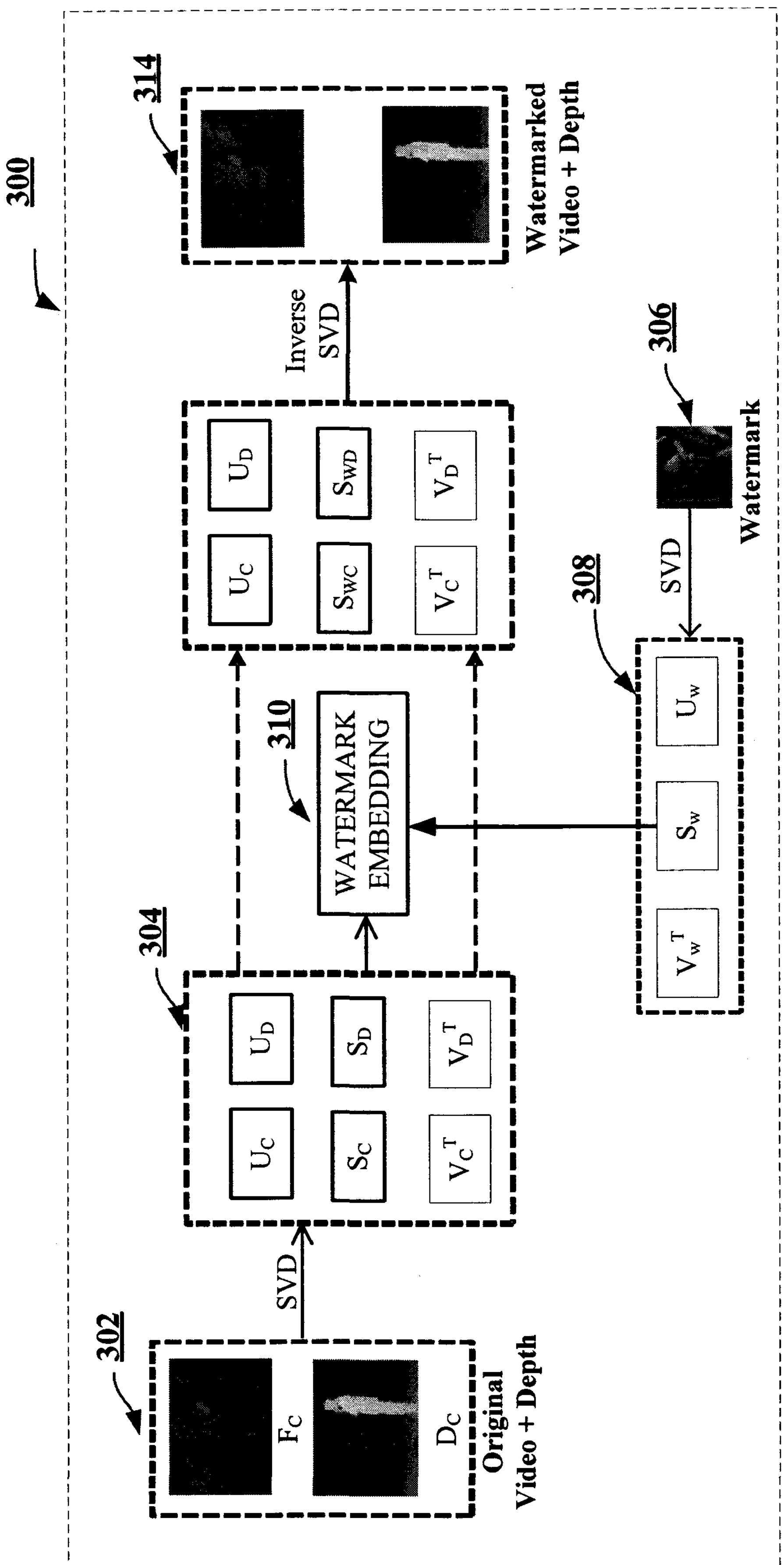

FIGURE 3
(PRIOR-ART)

Ajay Kumar Sarkar
Infosys Limited
Agent No. : 1652

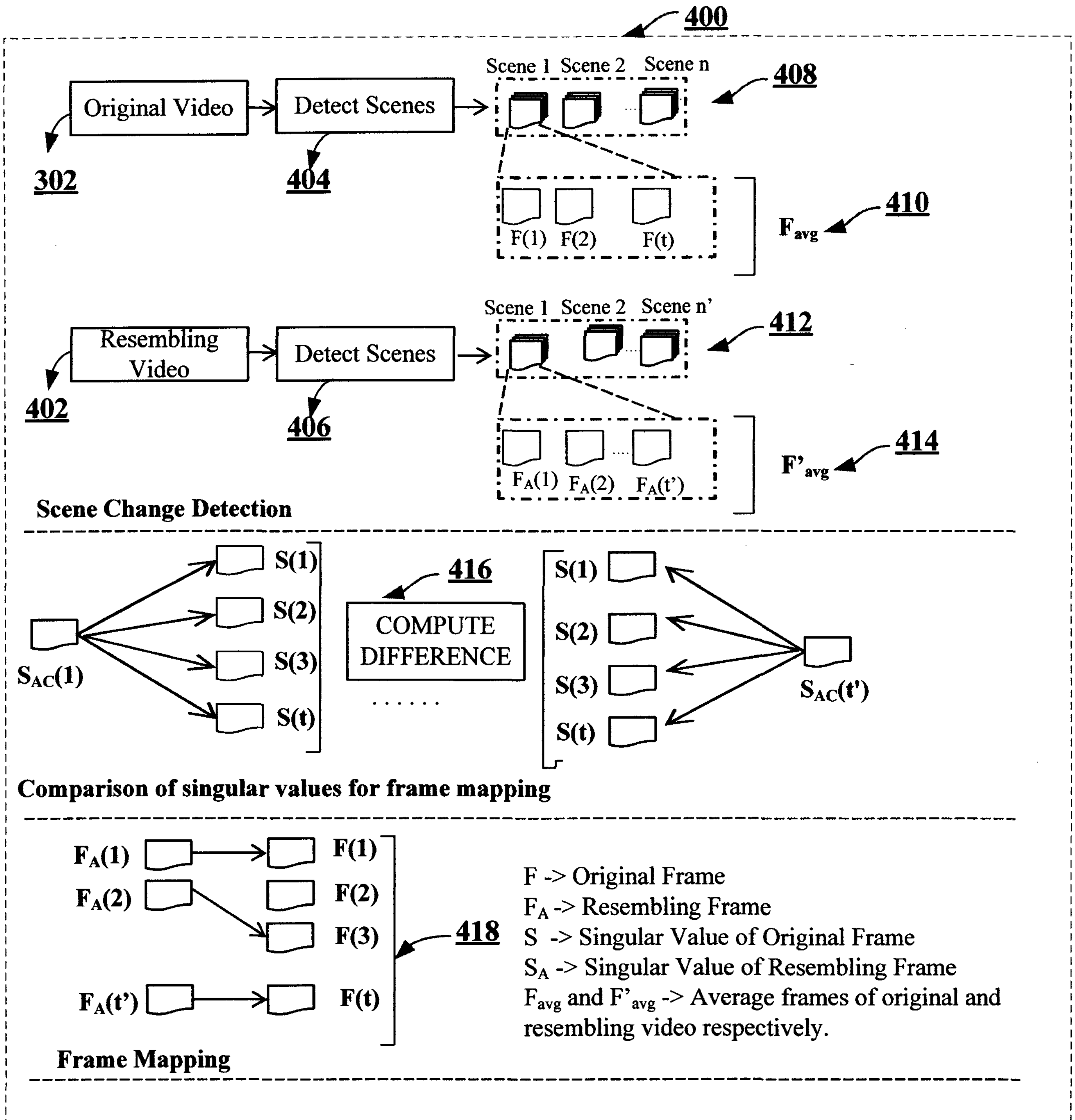

FIGURE 4

Ajay Kumar Sarkar
Infosys Limited
Agent No. : 1652

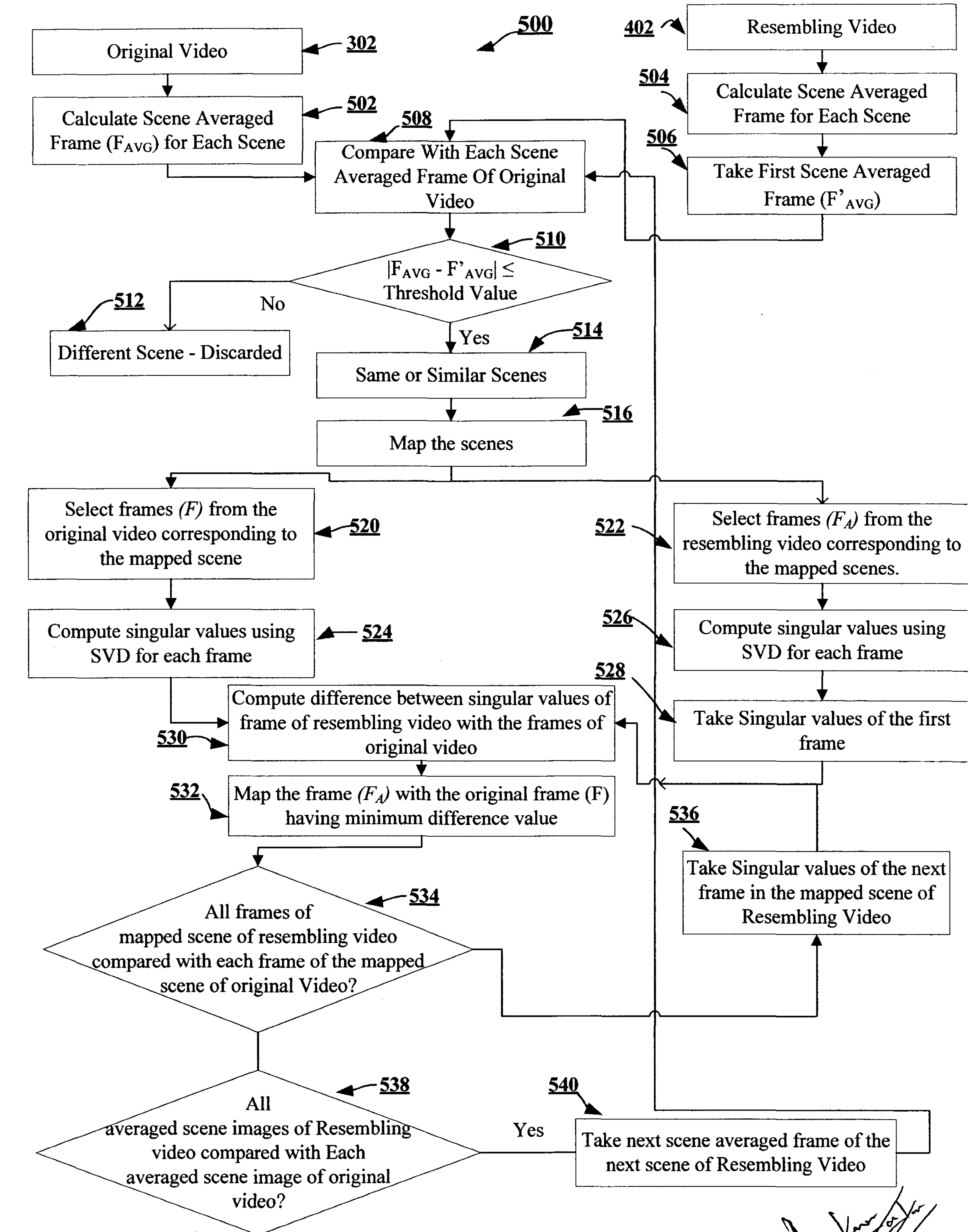

FIGURE 5

Ajay Kumar Sarkar
Infosys Limited
Agent No. : 1652

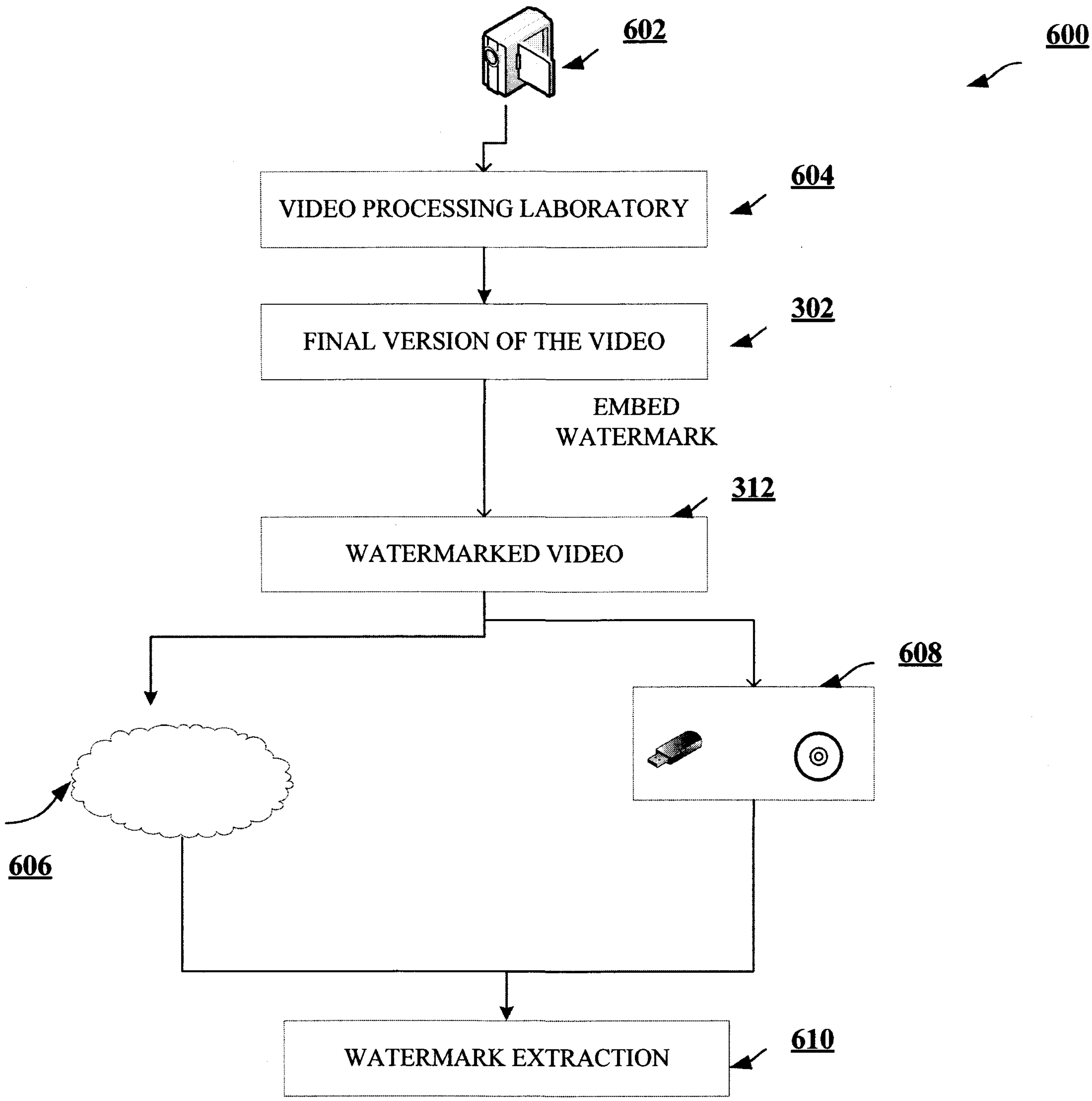

FIGURE 6
(PRIOR-ART)

Ajay Kumar Sarkar
Infosys Limited
Agent No. : 1652

SYSTEM FOR DETERMINING AN ILLEGITIMATE THREE DIMENSIONAL VIDEOS AND METHODS THEREOF

FIELD OF THE INVENTION

[0001] The present invention relates to the field of multimedia security. In particular, the present invention provides a computer-implemented method, system, and computer readable medium for determining an illegitimate three dimensional video.

BACKGROUND OF THE INVENTION

[0002] With the advancement in display technology, circuit design, and signal processing, it has become feasible to capture and render three dimensional (3D) videos on consumer platforms. A video is a sequence of scenes and a scene is a sequence of images called frames. Three dimensional videos have been recognized as one of the essential parts of next-generation visual media. Three dimensional videos may be represented using either stereo image recording (hereinafter may be referred to as 'SIR') or depth-image-based rendering (hereinafter may be referred to as 'DIBR'). In SIR, left and right views for the same scene are captured simultaneously using different camera positions. Although the video is of a high quality, there are several drawbacks which limit its applicability in real-time applications. Firstly in SIR, both the cameras should have same parameters such as contrast, height, and brightness. It is very difficult and costly to set both the cameras with same parameters. DIBR, on the other hand, requires one center view and corresponding depth map. Virtual left and right views are generated by mapping the center view with its corresponding depth map to provide three dimensional experiences. In contrast to SIR, it offers several advantages. Firstly, depth degree is adjustable in the DIBR systems which help the viewers to adjust the depth condition they prefer. As the depth map is an 8-bit gray scale image, it requires less storage space and low transmission bandwidth. Further, center view video consists of color frames and can be used independently as two dimensional video i.e. DIBR systems have backward compatibility with the widely used two dimensional systems.

[0003] The convergence of networks, devices, and services combined with the technological advancements in digital storage, multimedia compression, and miniaturization of digital cameras has led to an explosive growth of online video content. In addition to the professionally produced video content, user-generated content and content produced by hardcore amateurs are also on the rise. Videos can easily be shared over the Internet using popular video sharing sites such as You Tube® and Yahoo! ® Video. Three dimensional videos can be illegally distributed in multiple ways, including, but not limited to, unauthorized distribution of both the center video as well as depth video, unauthorized distribution of center video and unauthorized distribution of either left or right synthesized view. Although the user experience is enhanced with the new means of content production, distribution, and monetization, it has made illegal reproduction and distribution of digital content easier. Piracy of digital media content is increasing day by day and is a major cause of worry for the digital content owners. To protect the authenticity of three dimensional videos, a number of watermarking algorithms have been proposed. Watermarking is the process of embedding a watermark into an object such as a video which can be extracted later on from the suspected files for proving the digital rights.

[0004] To protect the copyright of three dimensional videos, few watermarking techniques have been proposed. Although a number of techniques exist for two dimensional watermarking, the mechanism to create and render two dimensional videos cannot be extrapolated to three dimensional videos since the nature of three dimensional videos differ from that of two dimensional videos. Three dimensional videos have depth-image-based rendering. DIBR videos have center view and depth map which are synthesized to generate left and right views to provide 3D experience. Koz et al. has proposed a watermarking scheme for the copyright protection of SIR three dimensional videos. The method is able to extract the watermark from known and unknown camera positions. Halici and Alatan have proposed a watermarking method for DIBR images. A watermark is embedded in spatial domain with a weighting factor. The method may not be robust against non-linear transformations such as rotation. Algorithms such as Singular Value Decomposition (hereinafter may be referred to as 'SVD') have gained importance due to its robustness to withstand attacks relative to algorithms such as Discrete Cosine Transform (hereinafter may be referred to as 'DCT') and Discrete Wavelet Transform (hereinafter may be referred to as 'DWT'). Various methods have been proposed to watermark digital images using SVD. However, the application of SVD in watermarking of videos is difficult. This limitation exists primarily due to temporal nature of videos, presence of special effects in videos, and non-blind nature of SVD based methods.

[0005] Therefore, there lies a need to overcome the limitations of existing technology. The present disclosure proposes improved computer-implemented methods and systems for determining illegitimate three dimensional videos using non-blind techniques.

SUMMARY OF THE INVENTION

[0006] Aspects of the disclosure relate to a system and methods for determining illegitimate three dimensional videos using non-blind techniques.

[0007] It is therefore an object of the present disclosure to provide systems and methods for watermarking three dimensional videos by taking center and depth video as independent channels of a three dimensional video.

[0008] It is another object of the present disclosure to provide systems and methods for employing a scene based matching process for mapping scenes of an original video and a resembling video.

[0009] It is yet another object of the present disclosure to provide systems and methods for frame based matching process for mapping frames of an original video and a resembling video.

[0010] The above as well as additional aspects and advantages of the disclosure will become apparent in the following detailed written description

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Features, aspects, and advantages of the present invention will be better understood when the following detailed description is read with reference to the accompanying drawings, wherein:

[0012] **FIG. 1 (PRIOR-ART)** is a block diagram of a computing device **100** to which the present disclosure may be applied according to an embodiment of the present disclosure.

[0013] **FIG. 2 (PRIOR ART)** is a block diagram illustrative of the process employed to render three dimensional videos.

[0014] **FIG. 3 (PRIOR ART)** is illustrative of a method **300** to embed a watermark in a three dimensional video **302.**

[0015] **FIG. 4** is illustrative of a method **400** to determine similar scene in a video.

[0016] **FIG. 4** is a block diagram depicting the scene mapping and frame mapping.

[0017] **FIG. 5** is illustrative of a method to map the scenes and frames as a pre-requisite to extract watermark from a three dimensional video.

[0018] **FIG. 6** is an embodiment, illustrative of the utility of the present disclosure.

DETAILED DESCRIPTION

[0019] Disclosed embodiments provide computer-implemented method, system, and computer-readable media for determining illegitimate three dimensional videos with DIBR as rendering technology. While the particular embodiments described herein may illustrate the invention in a particular domain, the broad principles behind these embodiments could be applied in other fields of endeavor. To facilitate a clear understanding of the present disclosure, illustrative examples are provided herein which describe certain aspects of the disclosure. However, it is to be appreciated that these illustrations are not meant to limit the scope of the disclosure and are provided herein to illustrate certain concepts associated with the disclosure.

[0020] The following description is full and informative description of the best method and system presently contemplated for carrying out the present disclosure which is known to the inventors at the time of filing the patent application. Of course, many modifications and adaptations will be apparent to those skilled in the relevant arts in view of the following description in view of the accompanying drawings and the appended claims. While the systems and methods described herein are provided with a certain degree of specificity, the present disclosure may be implemented with either greater or lesser specificity, depending on the needs of the user. Further, some of the features of the present disclosure may be used to advantage without the corresponding use of other features described in the following paragraphs.

[0021] Any headings used herein are for organizational purposes only and are not meant to limit the scope of the description or the claims. As a preliminary matter, the definition of the term "or" for the purpose of the following discussion and the appended claims is intended to be an inclusive "or" That is, the term "or" is not intended to differentiate between two mutually exclusive alternatives. Rather, the term "or" when employed as a conjunction between two elements is defined as including one element by itself, the other element itself, and combinations and permutations of the elements. For example, a discussion or recitation employing the terminology "A" or "B" includes: "A" by itself, "B" by itself and any combination thereof, such as "AB" and/or "BA." As used herein, the word "may" is used in a permissive sense rather than the mandatory sense. Similarly, the words "include", "including", and "includes" mean including, but not limited to.

[0022] It is also to be understood that the present disclosure may be implemented in various forms of hardware, software, firmware, special purpose processors, or a combination thereof. Preferably, the present disclosure is implemented in software as a program tangibly embodied on a program storage device. The program may be uploaded to, and executed by, a machine comprising any suitable architecture. One or more of the above-described techniques may be implemented in or involve one or more computer systems.

[0023] FIG. 1 (PRIOR-ART) is a block diagram of a computing device **100** to which the present disclosure may be applied according to an embodiment of the present disclosure. The system includes at least one processor **102**, designed to process instructions, for example computer readable instructions (i.e., code) stored on a storage device **104**. By processing instructions, processing device **102** may perform the steps and functions disclosed herein. Storage device **104** may be any type of storage device, for example, but not limited to an optical storage device, a magnetic storage device, a solid state storage device and a non-transitory storage device. The storage device **104** may contain an application **104a** which is a set of instructions (i.e. code). Alternatively, instructions may be stored in one or more remote storage devices, for example storage devices accessed over a network or the internet **106**. The computing device also includes an operating system and microinstruction code. The various processes and functions described herein may either be part of the microinstruction code or part of the program (or combination thereof) which is executed via the operating system. Computing device **100** additionally may have memory **108**, an input controller **110**, and an output controller **112** and communication controller **114**. A bus (not shown) may operatively couple components of computing device **100**, including processor **102**, memory **108**, storage device **104**, input controller **110** output controller **112**, and any other devices (e.g., network controllers, sound controllers, etc.). Output controller **112** may be operatively coupled (e.g., via a wired or wireless connection) to a display device (e.g., a monitor, television, mobile device screen, touch-display, etc.) in such a fashion that output controller **112** can transform the display on display device (e.g., in response to modules executed). Input controller **110** may be operatively coupled (e.g., via a wired or wireless connection) to input device (e.g., mouse, keyboard, touch-pad, scroll-ball, touch-display, etc.) in such a fashion that input can be received from a user. The communication controller **114** is coupled to a bus (not shown) and provides a two-way coupling through a network link to the internet **106** that is connected to a local network **116** and operated by an internet service provider (hereinafter referred to as 'ISP') **118** which provides data communication services to the internet. Members or subscribers of social media may be connected to the local network **116.** A network link typically provides data communication through one or more networks to other data devices. For example, network link may provide a connection through local network **116** to a host computer, to data equipment operated by an ISP **118**. A server **120** may transmit a requested code for an application through internet **106**, ISP **118**, local network **116** and communication controller **114**. Of course, **FIG. 1** illustrates computing device **100** with all components as separate devices for ease of identification only. Each of the components may be separate devices (e.g., a personal computer connected by wires to a monitor and mouse), may be integrated in a single device (e.g., a mobile device with a touch-display, such as a smartphone or a tablet), or any combination of devices (e.g., a computing device operatively coupled to a touch-screen display device, a plurality of computing devices attached to a single display device and input device, etc.). Computing device **100** may be one or more servers, for example a farm of networked servers, a clustered server environment, or a cloud network of computing devices.

[0024] A three dimensional DIBR video is essentially represented as video and depth. This format is eye-catching as inclusion of depth enables display independent solution for three dimensional that supports generation of an increased number of views, which may be required by different three dimensional displays. In DIBR video, depth data tells about the distance of the objects from the camera in the three dimensional view. DIBR systems wrap the center video data frame according to the values contained in the depth frame and fill the holes to synthesize left-eye and right-eye virtual views. Depth frames are pre-processed in order to generate more natural virtual views.

[0025] FIG. 2 (PRIOR ART) is a block diagram illustrative of the process employed to render three dimensional videos. The depth channel of a three dimensional video is pre-processed **202.** Pre-processing **202** of depth channel is done to reduce the large holes so as to maintain the quality of virtually synthesized left and right views. The next step is the frame wrapping **204** which aims at generating the virtual left and right views by mapping the pixels of center video frame to the corresponding depth frame. The pixels in depth video frame range from Z_{near} toZ_{far}, where Z_{near} and Z_{far} denotes the nearest and farthest planes in the 3D view. For an 8-bit depth map, the pixel value ranges from 0 to 255. The pixels of depth map are mapped with pixels of center video frame using below equations.

[0026] $x_L = x_c + \left(\frac{t_x}{2} \times \frac{f}{Z}\right)$ *Equation. I*

[0027] $x_R = x_c - \left(\frac{t_x}{2} \times \frac{f}{Z}\right)$ *Equation. II*

[0028] where x_C, x_R, and x_L are the x-coordinate of the pixels in the center frame (F_C), synthesized right frame (F_{VR}) and synthesized left frame (F_{VL}) respectively. f is the focal length, t_x is the baseline distance and Z is the value of the pixel indepth video frame (D_C) corresponding to center video frame pixel.

[0029] According to the visibility property of a three dimensional frame, the objects which are near will occlude the distant objects. Hence, farthest depth value pixels are wrapped first.

[0030] When center video frame is wrapped with corresponding depth frame, holes or disocclusions are revealed. Neither center video frame nor corresponding depth video frame contains any texture information about the holes or disocclusion area. To fill these newly exposed areas, hole filling **206** is applied using either an average filter or an interpolation. Known methods, for example, linear interpolation may be applied for filling the holes or disocclusions.

[0031] Disclosed systems and methods treat center video and depth as independent channels for the purpose of watermarking. It is assumed that any modification or alteration with the center video information will have similar impact on the depth information. Watermark is embedded independently in center video as well as depth video by employing a non-blind video watermarking algorithm such as SVD. SVD is a linear algebraic technique which optimally decomposes matrices to represent a maximum amount of signal energy in as few coefficients as possible. While using the SVD transformation a matrix is decomposed into three matrices *U*, *S*, and *V*. *U* and *V* are the orthogonal matrices and *S* is a diagonal matrix. The SVD is a technique that can be used in image compression techniques, but can also be applied to watermarking. The

SVD is performed, after which the singular values are usually modified to embed the watermark. A pseudo-inverse SVD is then applied to obtain the original content. The proposed method specifically employs S component for embedding watermark in each channel. Video consists of several scenes and each scene consists of several frames. As the watermarking process is non-blind, an efficient mapping process is proposed to avoid such synchronization issues. Frames of the original video are mapped with the resembling video before extracting the watermark. The proposed method uses scene based mapping process at the watermark extractor side to map the possibly resembling frames with the original frames. The first step is watermark embedding procedure and the next step is watermark extracting procedure.

[0032] **FIG. 3 (PRIOR ART)** is illustrative of a SVD based watermarking method **300** to embed a watermark in a three dimensional video **302**. For embedding the watermark, SVD of the center video frame, $F_C^{N\times M}$, and corresponding depth frame, $D_C^{N\times M}$, is computed **304** as:

[0033] $F_C = U_C\, S_C\, V_C^T$ *Equation III*

[0034] $D_C = U_D\, S_D\, V_D^T$ *Equation IV*

[0035] where:

[0036] U_C and V_C are the orthogonal matrices of center video frame F_C of three dimensional video **302**

[0037] S_C is the diagonal matrix of center video frame F_C of three dimensional video **302**

[0038] U_D and V_D are the orthogonal matrices of depth frame D_C of three dimensional video **302**

[0039] S_D is the diagonal matrix of corresponding depth frame D_C of three dimensional video **302**

[0040] The watermark $W^{n \times m}$ **306** is obtained and its SVD is computed **308** as:

[0041] $W = U_w S_w V_w^T$ *Equation V*

[0042] where

[0043] U_w and V_w are the orthogonal matrices of watermark W

[0044] S_w is the diagonal matrix of watermark W.

[0045] The watermark $W^{n \times m}$ is embedded **310** inside the center video frame $F_C^{N \times M}$ and corresponding depth frame $D_C^{N \times M}$ to obtain watermarked center video frame $F_{WC}^{N \times M}$ and depth $D_{WC}^{N \times M}$ frames **312** as:

[0046] $F_{WC} = U_C\,(S_C + \alpha \times S_w)V_C^T = U_C\,S_{WC}\,V_C^T$ *Equation VI*

[0047] $D_{WC} = U_D\,(S_D + \beta \times S_w)V_D^T = U_D\,S_{WD}\,V_D^T$ *Equation VII*

[0048] Where:

[0049] α and β represents the watermark embedding strength in center video frame and corresponding depth frame respectively. Watermarked center video F_{WC} and depth video D_{WC} are then rendered using the method discussed in **FIG. 2** to obtain the synthesized left and right video respectively.

[0050] **FIG. 4** in conjunction with **FIG. 5** is a block diagram depicting the scene and frame mapping process. For non-blind and semi-blind watermarking methods, method to map the scenes and frames is a pre-requisite in order to extract the watermark from a three dimensional watermarked video. Any addition or deletion of scene will lead to change in the order of the scenes. To avoid such synchronization issues, an efficient mapping process is required to map the frames of original video **302** with the resembling video **402**. A scene based approach has been used for mapping the resembling frames with the original frames. Depth frame carries only distance information about the objects which are present in the center video frame while center video frame carries most information such as texture information about the three dimensional view. According to an embodiment of the present disclosure, center video frames are used for detecting the scenes. Scenes of both the original three dimensional center video **302** and the possibly resembling three dimensional center video **402** may be detected using known scene detection methodologies. The respective videos are read and scenes are detected **404, 406**. A scene change detection algorithm is applied to determine the number of scenes in the video **408, 412**. Known scene change detection may be applied. Preferably, scene change detection method disclosed in patent application titled '*System for Scene Based Video Watermarking and Methods thereof*' may be employed. Assume that there are n and n' scenes in the original video **408, 410** and resembling video 412, 414 respectively. A scene averaged frame **410** is used as a unique scene identifier for scene mapping. However, other unique identifiers such as Discrete Cosine Transforms (DCT) coefficients may be used. The term, scene averaged frame, as used herein, means an average of the corresponding pixels of all the frames in a given scene. Let us suppose that F_{avg} **410, 502** and F'_{avg} **414, 506** be the scene averaged frames of original **302** and resembling center video respectively **402**. The scenes in each of the original video and the resembling video is detected and mapped against each other. The scene averaged image of the first scene of the resembling video **506** is compared with scene averaged image of each scene of the original video **508**. If the difference **416** between scene averaged frame of a scene of the original video and that of the resembling video is lesser or equivalent to a preconfigured threshold value **510,** then the two scenes are the same or a close match **514**. If the value is more than the threshold value then the two scenes may be considered as different scenes **512**. This process is repeated until the last scene of the original video **516, 538**. The set of mapped scenes can be examined further for frame mapping. Frames from scenes of the original video **520** are compared with frames from corresponding mapped scenes of the resembling video **522.** Singular values are computed using SVD for each frame of the mapped scenes **524, 526**. The frames $F_{AC}^{M' \times N'}$ of the mapped scenes of the resembling video are decomposed into one singular matrix $S_{AC}^{N' \times M'}$ and two orthogonal matrices – $U_{AC}^{N' \times N'}$ and $V_{AC}^{M' \times M'}$ as:

[0051] $F_{AC} = U_{AC}\, S_{AC}\, V_{AC}^{T}$ *Equation VIII*

[0052] Compute the difference **416, 528, 530** between the singular values of resembling frame S_{AC} with the singular values of original frames S_C as:

[0053] $diff = (\sum|S_{AC} - S_C(1)|, \ldots, \sum|S_{AC} - S_C(t)|)$ *Equation IX*

[0054] where:

[0055] t denotes the number of frames in the corresponding scene of original video **302**.

[0056] The resembling frame for which the difference is minimum with the original frame will be the matching frame **418, 532**. This is repeated until each frame of the resembling video is mapped with each frame of the original video **534, 536.** Frames in resembling video with no corresponding frame match in corresponding scene of original video are discarded **538**. Now, the frames have been mapped and the watermark can be extracted from the mapped frames of the resembling video. Suspected video files could be: (i) center video and corresponding depth video,

(ii) center video, (iii) synthesized left view video, and (iv) synthesized right view video. Watermark is extracted from these suspected files as:

[0057] $W'_C = U_w \left(\frac{S_{AC} - S_C}{\alpha}\right) V_w^T$ *Equation X*

[0058] $W'_D = U_w \left(\frac{S_{AD} - S_C}{\beta}\right) V_w^T$ *Equation XI*

[0059] $W'_L = U_w \left(\frac{S_{AL} - S_C}{\alpha}\right) V_w^T$ *Equation XII*

[0060] $W'_R = U_w \left(\frac{S_{AR} - S_C}{\alpha}\right) V_w^T$ *Equation XIII*

[0061] where

[0062] S_{AC}, S_{AD}, S_{AL}, and S_{AR} are the singular values of the resembling center video frame, corresponding depth frame, synthesized left view video frame and synthesized right view video frame respectively.

[0063] W'_C, W'_D, W'_L, and W'_R are the watermarks extracted from the center video frame, depth video frame, synthesized left view video frame, and synthesized right view video frame respectively.

[0064] FIG. 6 (PRIOR-ART) is an embodiment, illustrative of the utility of the present disclosure. A video **302**, which is captured by a camera **602** may be processed inside a video processing laboratory **604**. The video **302** created for an intended purpose is watermarked with the watermark information for example, owner's information. A watermark is a visible, or preferably invisible, identification data that is permanently embedded in the digital data, that is, it remains present within the data after any encoding and decoding process. The embedded watermark information can be recovered from the unauthorized copy which is created by imitating the watermarked video and can be used for protecting the digital right violations. The watermarked video **314** may be available through multiple channels to an end-user through a communication network **606** or in the form of a physical media **608** as the case maybe. In case of downloading video from Internet, a download request is sent from a computer to Internet for a video. The download reaches the Web server through a network. The Web server may be operatively connected to a server with an application **104a.** An end-user downloads the video and may distribute this video to unauthorized consumers. Any suspect copy of a video may be validated for its authenticity to determine if it is an illegal copy by extracting the watermark information. The extracted watermark **610** contains the watermark information which can be used to establish digital rights.

[0065] Having described and illustrated the principles of our invention with reference to described embodiments, it will be recognized that the described embodiments may be modified in arrangement and detail without departing from such principles.

[0066] While the present invention has been related in terms of the foregoing embodiments, those skilled in the art will recognize that the invention is not limited to the embodiments depicted. The present invention may be practiced with modification and alteration within the spirit and scope of the appended claims. Thus, the description is to be regarded as illustrative instead of restrictive on the present invention.