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NONPUBLICATION REQUEST UNDER 35 U.S.C. 122(b)(2)(B)(i)

First Named Inventor	SANDREW
Title	IMAGE SEQUENCE DEPTH ENHANCEMENT..
Attorney Docket Number	LF-P0029

I hereby certify that the invention disclosed in the attached application **has not and will not be** the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

I hereby request that the attached application not be published under 35 U.S.C. 122(b).

/JJM53288/ — Signature

8/17/2009 — Date

Joseph J. Mayo — Typed or printed name

53,288 — Registration Number, if applicable

858-442-5877 — Telephone Number

This request must be signed in compliance with 37 CFR 1.33(b) and submitted with the application **upon filing.**

Applicant may rescind this nonpublication request at any time. If applicant rescinds a request that an application not be published under 35 U.S.C. 122(b), the application will be scheduled for publication at eighteen months from the earliest claimed filing date for which a benefit is claimed.

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UNITED STATES UTILITY PATENT APPLICATION

IMAGE SEQUENCE DEPTH ENHANCEMENT SYSTEM AND METHOD

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This application is a continuation in part of U.S. Utility Patent Application Serial No. 12/032,969, issued as U.S. Patent 7,577,312, which is a continuation of U.S. Patent 7,333,670 filed 4 January 2006, which is a divisional of U.S. Patent 7,181,081, filed June 18th, 2003 which is a national stage entry of Patent Cooperation Treaty Application Serial No. PCT/US02/14192, filed May 6th, 2003, which claims the benefit of United States Provisional Patent Application 60/288,929 filed May 4th, 2001, the specifications of which are all hereby incorporated herein by reference.

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[001] One or more embodiments of the invention are related to the field of image analysis and image enhancement, (suggested class 382, subclass 254). More particularly, but not by way of limitation, one or more embodiments of the invention enable an image sequence depth enhancement system and method that allows for the rapid conversion of a sequence of two-dimensional images into three-dimensional images.

DESCRIPTION OF THE RELATED ART

[002] Known methods for the colorizing of black and white feature films involved the identification of gray scale regions within a picture followed by the application of a pre-selected color transform or lookup tables for the gray scale within each region defined by a masking operation covering the extent of each selected region and the subsequent application of said masked regions from one frame to many subsequent frames. The primary difference between US Patent No. 4,984,072, System And Method For Color Image Enhancement, and US Patent No. 3,705,762, Method For Converting Black-And-White Films To Color Films, is the manner by which the regions of interest (ROIs) are isolated and masked, how that information is transferred to subsequent frames and how that mask information is modified to conform with changes in the underlying image data. In the 4,984,072 system, the region is masked by an operator via a one-bit painted overlay and operator manipulated using a digital paintbrush method frame by frame to match the movement. In the 3,705,762 process, each region is outlined or rotoscoped by an operator using vector polygons, which are then adjusted frame by frame by the operator, to create animated masked ROIs.

[003] In both systems the color transform lookup tables and regions selected are applied and modified manually to each frame in succession to compensate for changes in the image data which

the operator detects visually. All changes and movement of the underlying luminance gray scale is subjectively detected by the operator and the masks are sequentially corrected manually by the use of an interface device such as a mouse for moving or adjusting mask shapes to compensate for the detected movement. In all cases the underlying gray scale is a passive recipient of the mask containing pre-selected color transforms with all modifications of the mask under operator detection and modification. In these prior inventions the mask information does not contain any information specific to the underlying luminance gray scale and therefore no automatic position and shape correction of the mask to correspond with image feature displacement and distortion from one frame to another is possible.

[004] Existing systems that are utilized to convert two-dimensional images to three-dimensional images generally require the creation of wire frame models for objects in images. The creation of wire frame models is a large undertaking in terms of labor. These systems also do not utilize the underlying luminance gray scale of objects in the images to automatically position and correct the shape of the masks of the objects to correspond with image feature displacement and distortion from one frame to another. Hence, great amounts of labor are required to manually shape masks for applying depth or Z-dimension data to the objects. Motion objects that move from frame to frame thus require a great deal of human intervention. In addition, there are no known solutions for enhancing two-dimensional images into three-dimensional images that utilize composite backgrounds of multiple images in a frame for spreading depth information to background and masked objects. Hence there is a need for an image sequence depth enhancement system and method.

BRIEF SUMMARY OF THE INVENTION

[005] Embodiments of the invention classify scenes to be colorized and/or converted from two-dimensional to three-dimensional into movies into two separate categories; either background elements (i.e. sets and foreground elements that are stationary) or motion elements (e.g., actors, automobiles, etc) that move throughout the scene. These background elements and motion elements are treated separately in this invention similar to the manner in which traditional animation is produced.

[006] Motion Elements: The motion elements are displayed as a series of sequential tiled frame sets or thumbnail images complete with background elements. The motion elements are masked in a key frame using a multitude of operator interface tools common to paint systems as well as unique tools such as relative bimodal thresholding in which masks are applied selectively to contiguous light or dark areas bifurcated by a cursor brush. After the key frame is fully designed and masked, all mask information from the key frame is then applied to all frames in the display-using mask fitting techniques that include:

[007] 1. Automatic mask fitting using Fast Fourier Transform and Gradient Decent Calculations based on luminance and pattern matching which references the same masked area of the key frame followed by all prior subsequent frames in succession.

[008] 2. Bezier curve animation with edge detection as an automatic animation guide

[009] 3. Polygon animation with edge detection as an automatic animation guide

[0010] In another embodiment of this invention, these background elements and motion elements are combined separately into single frame representations of multiple frames, as tiled frame sets or as a single frame composite of all elements (i.e., including both motion and backgrounds/foregrounds) that then becomes a visual reference database for the computer controlled application of masks within a sequence composed of a multiplicity of frames. Each pixel address within the reference visual database corresponds to mask/lookup table address within the digital frame and X, Y, Z location of subsequent "raw" frames that were used to create the reference visual database. Masks are applied to subsequent frames based on various differentiating image processing methods such as edge detection combined with pattern recognition and other sub-mask analysis, aided by operator segmented regions of interest from reference objects or frames, and operator

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