(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 April 2002 (04.04.2002)

PCT

(10) International Publication Number
WO 02/27667 A1

(51) International Patent Classification[7]: G06T 17/00

(21) International Application Number: PCT/US01/28563

(22) International Filing Date:
14 September 2001 (14.09.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/232,410 14 September 2000 (14.09.2000) US

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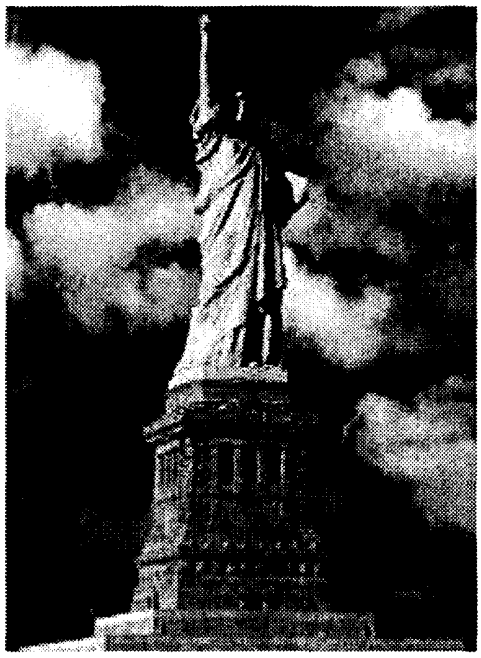
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

[Continued on next page]

(54) Title: METHOD FOR AUTOMATED TWO-DIMENSIONAL AND THREE-DIMENSIONAL CONVERSION



A "TIFF" Digital Image

(57) Abstract: The present invention provides a method for controlling known optical principles for the conversion of a single master image (1) into a plurality of images, performing parallax shift (1.1-1.4), and interphasing the images into a single, master image (1.5). The master image when viewed through a MOM (2.3), has a large variety of visual uses and applications including but not limited to three-dimensional, flip, morph, zoom and action.

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METHOD FOR AUTOMATED TWO-DIMENSIONAL AND THREE-DIMENSIONAL CONVERSION

BACKGROUND OF THE INVENTION

[0001] Priority of this application is based on U.S. Provisional Application No. 60/232,410, filed on September 14, 2000, which is hereby incorporated by reference.

Field of the Invention

[0002] The present invention relates to image processing and fixation and, more particularly, to a method for converting a two-dimensional image to a multiple images and interphasing back to a single image for fixation and display as a three-dimensional image.

Statement of the Related Art

[0003] Three-dimensional photography is well-known but has presented problems relating to its need for special cameras, special processing, and trained personnel. Multiple lens overlays have been used for display of images having an appearance of three dimensions, but these have the same shortcomings, namely, a requirement for special equipment and specially trained personnel.

[0004] Accordingly, a need has been recognized by the present inventors for a making three-dimensional viewing of existing two-dimensional images more accessible and

economical while, at the same time, requiring minimal skill for generating quality images. Preferably, the method would utilize a conventional general purpose programmable computer ("PC"), without any hardware changes.

Summary of the Invention

[0005] An example embodiment of the present invention includes a step of receiving a two-dimensional pixel image data file into a data storage, the two-dimensional image file having pixel data reflecting a plurality of objects, and a step retrieving the two-dimensional pixel image data file and a step of displaying an image corresponding to the image file on a video display. The next step receives segmentation command indicating an initial border for at least one of the objects. The next step receives a border refinement command having parameters for generating a final border for at least one of the objects, the parameters being from a group consisting of one or more of color, noise frequency, and edge softness.

[0006] A following step of the first example embodiment segments the image file into a plurality of images based on the segmentation command and the border refinement command. Next, in-painting of at least one of the plurality of images is performed which fills a portion of the at least one image with a pixels generated based on pixels within the object represented by the at least one

image file. A subsequent step receives a first depth data and second depth data for at least a first and a second of the plurality images. Next, a parallax shift step generates at least two phase-shifted images for each of the at least first and second of the plurality of images, the two phase-shifted images having a parallax shift with respect to one another and with respect to at least one other of the plurality of images, the parallax shift being based on the depth data for that image. Next, the plurality of phase-shifted images are interphased into a single interphased image file for output and printing.

[0007] A further aspect of a method according to this invention includes a further step of receiving a plurality of two-dimensional image files, and overlaying these into a single two-dimensional image file for the segmentation step.

SUMMARY OF THE INVENTION

Application of the principles of optics and three-dimensional photograph in a computer program algorithm shows the needs described above to be fulfilled. The ramifications of this program extend to many disciples such as medicines, advertising, photography, novelties, virtual reality hard copy, and the like.

The present invention provides a software package controlled by optical principles for the conversion of a single digital input image to multi images and then interphasing back to a single master image. The new image created a program has intensified information. This image when viewed through optical material, has a large variety of visual uses and applications including but not limited to three-dimensional, flip, morph, zoom and action.

[0008] In addition, with the software program of this invention, the same interphasing segment can be used when multiple images are input to produce three dimensions from multiple image cameras in the case of different or sequential images, flip, morph, zoom or action images are produced.

Brief Description of the Drawings

[0009] FIG. 1 is a perspective view of a first example two-object corresponding to pixel image file;

[0010] FIGS. 1.1, 1.2, 1.3 and 1.4 show an example first, second, third and fourth parallax-shifted image, corresponding to a parallax shifting step according to the present invention of the FIG. 1 image;

[0011] FIG. 1.5 shows an interphased image based on interphasing according to the present invention of the FIGS. 1.1 through 1.4 images;

[0012] FIG. 1.6 shows a close up of an example portion of the interphased image shown in FIG. 1.5;

[0013] FIG. 2.0 shows the FIG. 1.5 example image fixed upon a media;

[0014] FIG. 2.1 shows an example foreground object from within the example image shown in FIG. 1 as fixed within the FIG. 2.0 image;

[0015] FIG. 2.2 shows an example background object from within the example image shown in FIG. 1 as fixed within the FIG. 2.0 image;

[0016] FIG. 2.3 depicts an example thin film multiple lens sheet for overlay on the FIG. 2.0 fixed image;

[0017] FIG. 2.4 shows an example image as would be seen by a human observer of the FIG. 2.0 image seen through the FIG. 2.3 multiple lens overlay;

[0018] FIG. 2.5 is a graphical representation of the eyes of the observer in FIG. 2.4;

[0019] FIGS. 3.1 - 3.5 depict an example segmentation and border refinement step within the method of this invention, for segmenting the two-dimensional image into a plurality of objects;

[0020] FIGS. 4.1 - 4.4 show a gap in the background object image corresponding to a plurality of parallax shifts in accordance with the method of this invention;

[0021] FIGS. 5.1 - 5.4 depict an inpainting step performed by the method of this invention for filling the gaps depicted in FIGS. 4.1 - 4.4;of a welded mount double clip according to the present invention.

Detailed Description of the Invention

[0022] With the advent of personal computers and high storage capabilities, it has become possible to convert single images into multiple images and then interphase these images back into a master file. This file can be output as a photograph through the use of special photographic principles combined with MOM to produce multi-image outputs, and/or multi-layered outputs with intensified visual data. As illustrated in FIGS. 1.1-4.4.

[0023] One software package of the present invention (not shown) effects conversion of a single digital input, two-dimensional image FIG. 1 to multi-images FIG. 1.1-1.4 and then interphases the images 1.1-1.4 back to a single master three-dimensional image FIG. 1.5 having intensified the information. Image 1.5 can be output as a photograph through the use of special photographic printers or printed out directly on standard PC printers and master you can clearly see each of the 4 input images FIG. 1.1-1.4.

[0024] As shown below when FIG. 2.0 displaying objects 2.1 and 2.2 through MOM FIG. 2.3 the resulting image FIG. 2.4 appears to the observer FIG. 2.5 as having three-dimensions, actions, flip or zoom.

[0025] FIG. 1.5 the following procedure is preferably followed. The initial two-dimensional image 1 and then subjected to a preparation phase, wherein the image undergoes segmenting involving the masking of each object FIG. 2.1-2.2 in the image by an edge detection method, e.g. "intelligent scissors". Magnetic Lasso of FIG. 3.1-3.4. The resulting object FIG 3.5 is segmented onto a separate layer.

[0026] Segmenting is the process by which the singe 2D image is separated into layers based on depth in the scene. This allows the layers to be shifted by different amounts to simulate parallax.

[0027] To begin the process of segmenting, the users first draws a rough border around the object to be separated FIG. 3.1-3.4. Next, by adjusting the threshold parameters to the segmenting algorithm, the user can dynamically refine the area without having to paint by hand. These adjustments can be refined for the whole image or just a particular region to allow more accurate segmentation. The parameters are color (hue, saturation, and brightness), noise frequency and edge softness. The user can adjust the rough point the user can "bake" or apply the parameters to the rough border which results in a new, more accurate rough edge border which can

further refined using the adjustable parameters or through hand painting in perspective and moving resulting in images FIG. 1.1-1.4. Next the images undergo "in-Painting" FIG. 4.1-4.4 (involving the painting and removal of holes that were created during the segmented step).

[0028] When the layers are shifted to simulate parallax, blank areas on the layers below will become possible. Our software will fill in these blanks "In-Painting" spaces automatically.

[0029] The algorithms calculates the pixels that will require filling. This is done through intersection and subtraction calculations on the masks or alpha channels of the layers above the current layer.

[0030] The software then uses a scanline algorithm, only filling one pixel per intersection per scanline until the area is filled. The color of each pixel is based on a weighted average of any surrounding pixels that already have color either from the original image or from earlier passes of this algorithm. The weight of each pixel is adjusted after each pass so that it relies evenly on top/bottom and right/left pixels for the first passes, and relies more heavily on the right/left pixels as the distance to original pixels increases.

[0031] For each layer, the user selects the depth by entering the value into the GUI edit field provided. Starting with the foreground, the software then assigns

layer order by taking the layers in the order in which they were selected. The software then accurately generates the frames necessary for the interphasing step. See FIG. 1.1-1.4.

[0032] Can be used when multiple images are input to produce three-dimensions from multiple image cameras, the case of different or sequential images, flip, morph, zoom or action images are produced.

[0033] To effect the conversion progress described above, the software package of this invention is controlled by the same optical principles used in three-dimensional photography. Such principles are described, for example in US Patent Nos. 3,852,787; 3,895,867; and 3,960,563; each of the references being hereby incorporated by reference herein in the entirety.

[0034] It should be understood that the particular embodiments shown in the drawings and described within this specification are for purposes of example and should not be construed to limit the invention which will be described in the claims below.

What is claimed is:

1. A method for converting a two-dimensional image file into a three dimensional image file, comprising steps of:

receiving a two-dimensional pixel image data file into a data storage, the two-dimensional image file having pixel data reflecting a plurality of objects;

retrieving the two-dimensional pixel image data file from said storage;

displaying an image corresponding to the image file on a video display;

receiving a segmentation command indicating an initial border for at least one of the objects;

displaying a border for the at least one object based on said segmentation command;

segmenting the image file into a plurality of images based on the segmentation command;

in-painting at least one of the plurality of images to fill a portion at least one of said plurality of images with fill pixels, said fill pixels generated based on pixels within an object represented by the at least one image file;

receiving a first depth data and a second depth data for at least a first and a second of the plurality images;

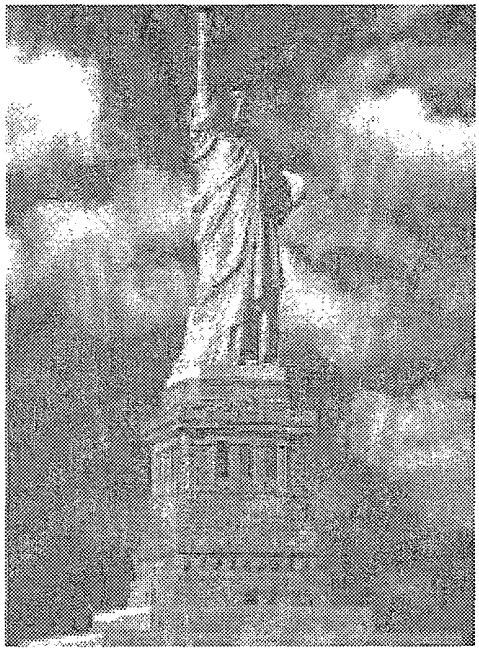
generating at least two phase-shifted images for each of the at least first and second of the plurality of images, the two phase-shifted images having a parallax shift with respect to one another and with respect to at least one other of the plurality of images, the parallax shift being based on the depth data for that image;

interphasing said phase-shifted images into a single interphased image file for output and printing.

28

29 2. A method according to claim 1 further comprising a step
30 of receiving a border refinement command having parameters
31 for generating a final border for at least one of the
32 objects, the parameters being from a group consisting of one
33 or more of color, noise frequency, and edge softness, and
34 wherein said segmentation is performed at least on part on
35 aid border refinement command.

FIG. 1



A "TIFF" Digital Image

FIG. 1-1 FIG. 1-2 FIG. 1-3 FIG. 1-4

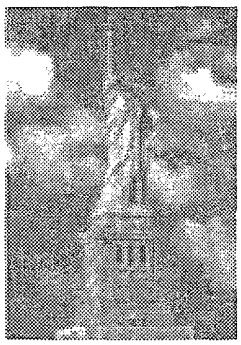
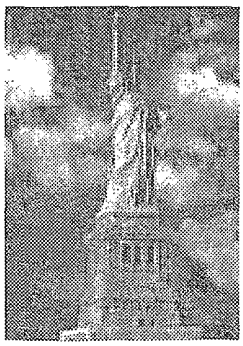
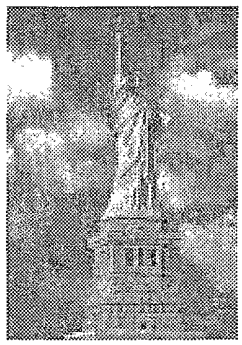
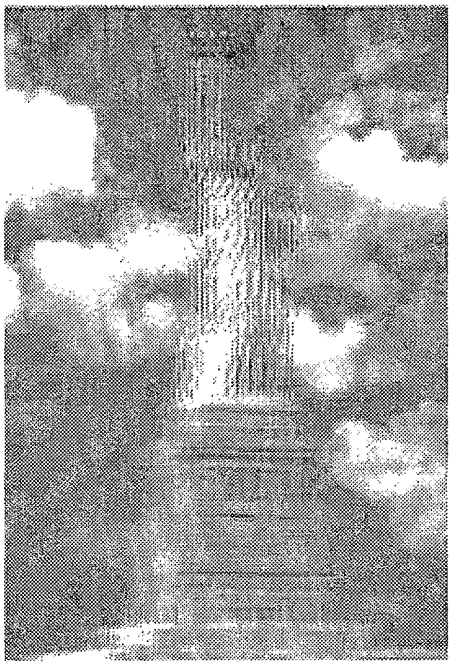
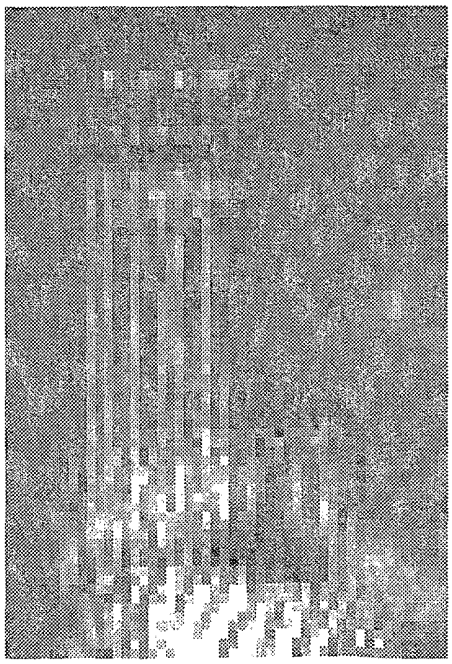





FIG. 1-5



A "TIFF" Digital Master

FIG. 1-6



Close up of the Digital Master

FIG. 2-1

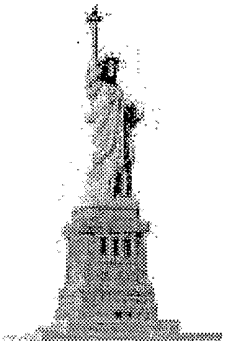


FIG. 2-2

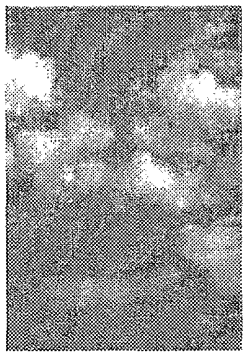


FIG. 2-3 FIG. 2

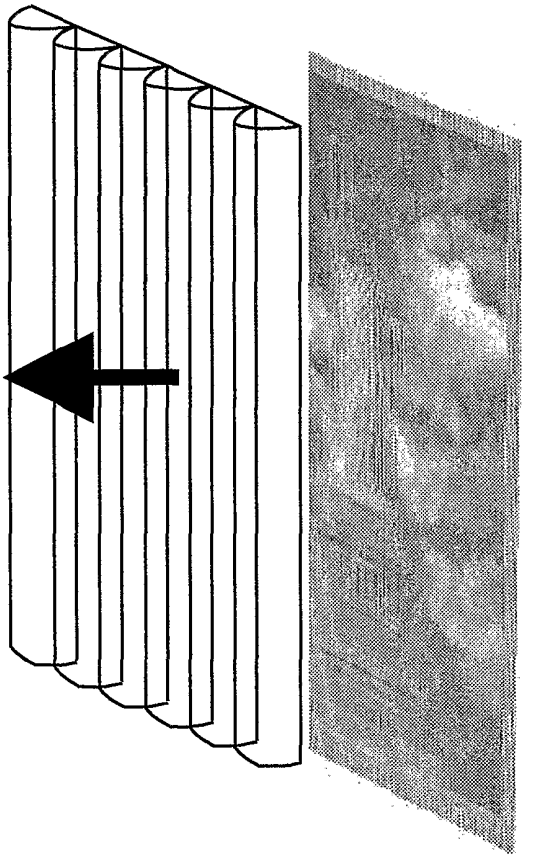


FIG. 2-5

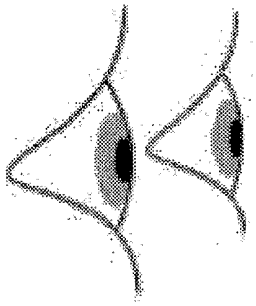


FIG. 2-4

FIG. 3-5

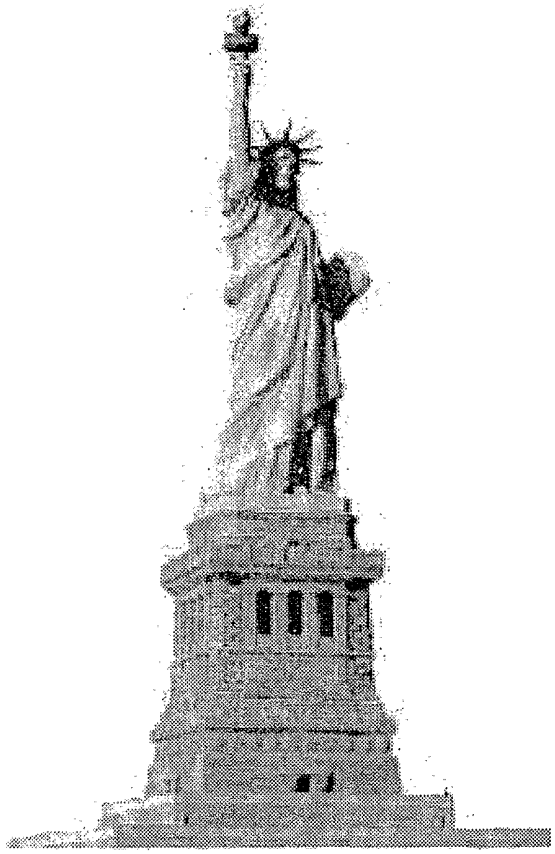


FIG. 3-1

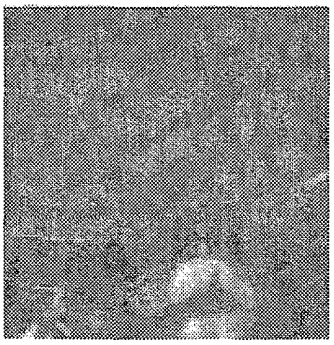


FIG. 3-2

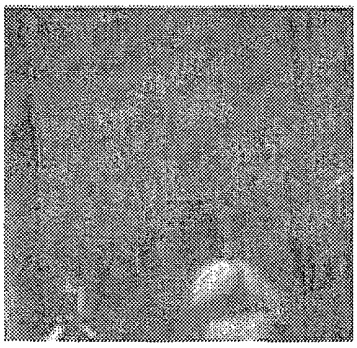


FIG. 3-3

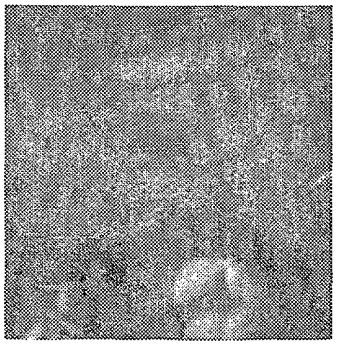


FIG. 3-4

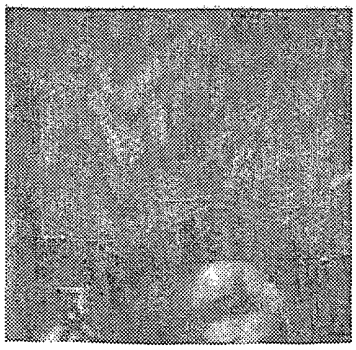


FIG. 4-3

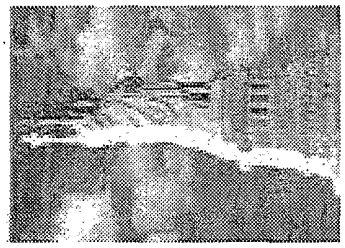


FIG. 5-4

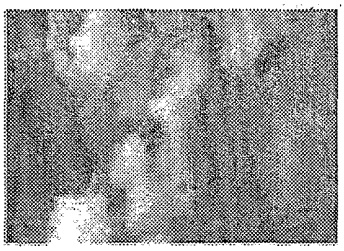


FIG. 4-3

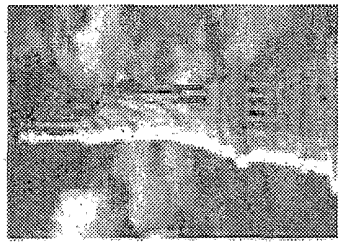


FIG. 5-3

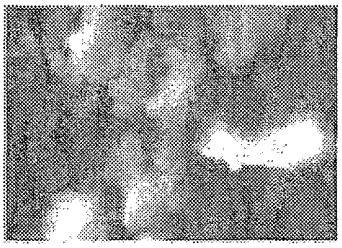


FIG. 4-2

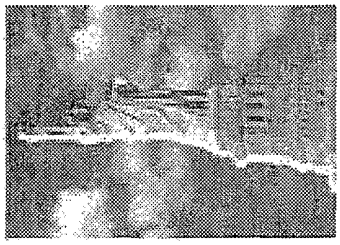


FIG. 5-2

FIG. 4-1

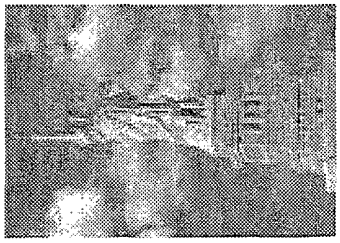
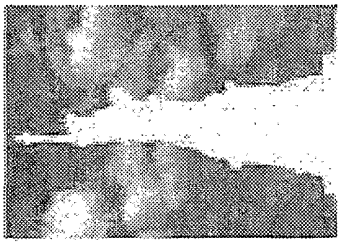


FIG. 5-1



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/28563

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G06T 17/00
US CL :382/154; 345/419; 348;43, 44
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 382/154, 285, 294, 305; 345/419; 348;43, 44; 396/324

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

US PATENTS, DERWENT, EPO ABSTRACTS, JPO ABSTRACTS, IBM, PG PUBS, IEEE, SPIE, AND ELSEVIER SCIENCE SERVER.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,925,294 A (GERSHWIND et al.) 15 May 1990, figure 1, column 4, lines 9-43 and column 6, lines 5-17.	1, 2

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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