STUDY OF LATEST OPTICAL INSTRUMENT VIRTUAL ENVIRONMENT NAVIGATION

Sumi Bordoloi, Research Scholar, Sunrise University, Rajasthan
Dr. Sachin Saxena, Supervisor, Sunrise University, Rajasthan

ABSTRACT

Customarily, virtual reality frameworks utilize 3D PC design to model and render virtual situations continuously. This approach more often than not requires difficult demonstrating and costly unique reason rendering equipment. The rendering quality and scene complexity are regularly restricted in light of the continuous imperative. This paper exhibits another approach which utilizes 360-degree barrel shaped all encompassing images to create a virtual domain. The all encompassing image is digitally distorted on-the-travel to reenact camera panning and zooming. The all encompassing images can be made with PC rendering, specific all encompassing cameras or by "sewing" together covering photos brought with a standard camera. Strolling in a space is presently expert by "jumping" to various all encompassing focuses. The image-based approach has been utilized as a part of the business item QuickTime VR, a virtual reality augmentation to Apple Computer's QuickTime digital media structure. The paper depicts the design, the document organize, the writing procedure and the intelligent players of the VR framework. Notwithstanding all encompassing survey, the framework incorporates review of a protest from various bearings and hit-testing through introduction free problem areas.

Keywords*: image warping, image registration, virtual reality, real-time display, view interpolation, environment maps, panoramic images.*

1 INTRODUCTION

A key segment in most virtual reality frameworks is the capacity to play out a walkthrough of a virtual domain from various review positions and introductions. The walkthrough requires the amalgamation of the virtual environment and the reproduction of a virtual camera moving in the earth with up to six degrees of flexibility. The union and route are generally refined with one of the accompanying two techniques.

1.1 3D Modeling and Rendering

Customarily, a virtual situation is orchestrated as a gathering of 3D geometrical substances. The geometrical substances are rendered progressively, frequently with the assistance of unique reason 3D rendering motors, to give an intelligent walkthrough encounter.

The 3D displaying and rendering approach has three fundamental issues. To begin with, making the geometrical elements is a difficult manual process. Second, on the grounds that the walkthrough should be performed progressively, the rendering motor more often than not puts a farthest point on scene complexity and rendering quality. Third, the requirement for an uncommon reason rendering motor has constrained the accessibility of virtual reality for the vast majority since the fundamental equipment is not generally accessible.

1.2 Branching Movies

Another way to deal with blend and explore in virtual situations, which has been utilized widely as a part of the computer game industry, is spreading films. Various motion picture fragments delineating spatial route ways are associated together at chose branch focuses. The client is permitted to proceed onward to an alternate way just at these fanning focuses. This approach for the most part uses photography or PC rendering to make the motion pictures. A PC driven simple or digital video player is utilized for intuitive playback. An early case of this approach is the motion picture outline, in which the boulevards of the city of Aspen were recorded at 10-foot interims. At playback time, two videodisk players were utilized to recover comparing perspectives to reenact the impacts of strolling in the city.

Objectives

In view of the deficiency of the current techniques, we chose to investigate another approach for the creation and route of virtual situations. In particular, we needed to build up another framework which met the accompanying goals:

In the first place, the framework ought to playback at intelligent speed on most PCs accessible today without equipment increasing speed. We didn't need the framework to depend on

exceptional information or yield gadgets, for example, information gloves or head-mount shows, in spite of the fact that we didn't block their utilization.

Second, the framework ought to suit both genuine and manufactured scenes. True scenes contain hugely rich points of interest frequently hard to model and render with a PC. We needed the framework to have the capacity to utilize true view straightforwardly without experiencing PC displaying and rendering.

Third, the framework ought to have the capacity to show astounding images autonomous of scene complexity. Numerous virtual reality frameworks regularly trade off by showing low quality images and/or disentangled situations to meet the ongoing presentation imperative. We needed our framework's show speed to be autonomous of the rendering quality and scene complexity.

1.4 Overview

This paper introduces an image-based framework for virtual environment route in view of the above destinations. The framework utilizes ongoing image handling to create 3D point of view survey impacts. The approach introduced is like the motion picture based approach and has similar focal points. It contrasts in that the motion pictures are supplanted with "introduction autonomous" images and the film player is supplanted with an ongoing image processor. The images that we at present utilize are tube shaped displays. The displays are introduction free in light of the fact that each of the images contains all the data expected to glance around in 360 degrees. Some of these images can be associated with frame a walkthrough arrangement.

2. RELATED WORK

The motion picture based approach requires each displayable view to be made and put away in the composing stage. In the film outline [4], four cameras are utilized to shoot the perspectives at each point, along these lines, giving the client the capacity to dish to one side and comfortable point. The Virtual Museum stores 45 sees for each 360-degree dish motion picture [3]. This outcomes in smooth panning movement however at the cost of more storage room and casing creation time.

The traversable motion picture [5] is another case of the motion picture based approach. Dissimilar to the film outline the Virtual Museum, which just have the panning movement in one heading, the

safe motion picture offers two-dimensional pivot. A protest is shot with a camera indicating at the question's middle and circling in both the longitude and the scope headings at approximately 10-degree increases. This procedure brings about several casings comparing to all the accessible review bearings. The casings are put away in a two-dimensional exhibit which are recorded by two rotational parameters in intuitive playback. While showing the protest against a static foundation, the impact is the same as pivoting the question. Panning to take a gander at a scene is proficient similarly. The edges for this situation speak to perspectives of the scene in various view introductions.

3. IMAGE-BASED RENDERING

The image-based approach displayed in this paper addresses the reproduction of a virtual camera's movements in photographic or PC orchestrated spaces. The camera's movements have six degrees of flexibility. The degrees of opportunity are gathered in three classes. To begin with, the three rotational degrees of flexibility, named "camera pivot", allude to turning the camera's view course while keeping the perspective stationary. This class of movements can be proficient with the reprojection of a situation guide and image turn. Second, circling a camera around an protest while keeping the view heading focused at the question is named "question pivot" since it is identical to turning the protest. This sort of movement requires the development of the perspective and can not be accomplished with a domain outline. Third, free movement of the camera in a space, named "camera development", requires the change of both the perspective and the review heading and has every one of the six degrees of opportunity. Notwithstanding the above movements, changing the camera's field-of-view, named "camera zooming", can be expert through different determination image zooming.

3.1 Camera Rotation

A camera has three rotational degrees of flexibility: pitch (turning around a level hub), yaw (rotating around a vertical pivot) and roll (pivoting around a hub typical to the view plane). Camera rolling can be accomplished unimportantly with an image revolution. Pitch and yaw can be expert by the reprojection of a situation delineate.

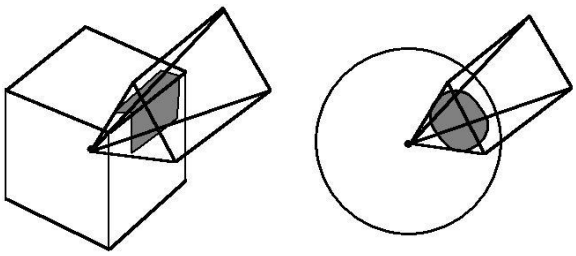

Figure 1. Reprojecting a cubic and a spherical environment map.

3.2 Object Rotation

As specified before, circling the camera around a question, comparable to pivoting the protest about its middle, can not be expert just with a domain delineate. One method for tackling this issue is the safe motion picture approach. The film contains outlines which relate to all the passable introductions of a question.

3.3 Camera Movement

A camera moving unreservedly in a scene includes the alter of perspective and view course. The view bearing change can be proficient with the utilization of a domain outline. The perspective change is more hard to accomplish.

For crossing in a 2D or 3D space, environment maps can be orchestrated to shape a 2D or 3D grid. Perspectives in space are essentially quantized to the closest lattice indicate rough the movement (figure 2). In any case, this approach requires a bigger number of environment maps to be put away so as to get smooth movement. A more attractive approach might be the view interjection strategy [18] or the surmised perceivability technique [12], which produces new perspectives from a coarse matrix of environment maps. Rather than obliging the development to the network focuses, the close-by environment maps are interjected to produce a smooth way.

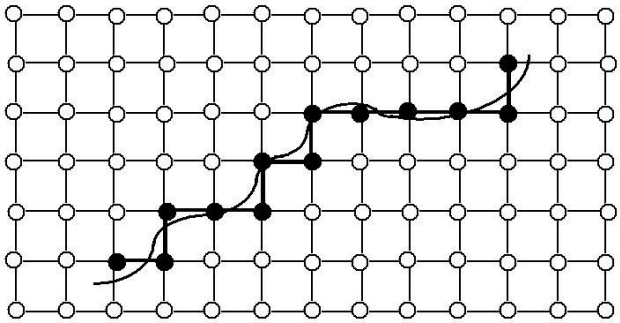

Figure 2. An unconstrained camera path and an approximated path along the grid lines.

3.4 Camera Zooming

Changing the camera's field of view is comparable to zooming done in the image space. Be that as it may, utilizing image amplification to zoom as a part of does not give more detail. Zooming out through image decrease may make associating antiquities as the examining rate falls beneath as far as possible. One arrangement is various determination image zooming.

4. QUICKTIME VR

The image-based approach has been executed in a business item called QuickTime VR, based on top of Apple Computer's QuickTime digital media structure. The present usage incorporates persistent camera panning and zooming, bouncing to chose focuses and protest pivot utilizing outline ordering.

The following sections briefly describe the movie format, the players and the process of making the movies.

4.1 The Movie Format

QuickTime VR currently includes two different types of movies: panoramic and object.

4.1.1 The Panoramic Movie

Traditional QuickTime motion pictures are one-dimensional compacted groupings recorded by time. Each QuickTime film may have numerous tracks. Every track can store a kind of straight media, for example, sound, video, content, and so forth. Every track sort may have its own player

to translate the data in the track. The tracks, which for the most part run parallel in time, are played synchronously with a typical time scale. QuickTime permits new sorts of tracks and players to be added to broaden its capacities. Allude to [24] and [25] for a point by point depiction of the QuickTime design.

A case of an all encompassing film document is appeared in figure 3. The all encompassing track is isolated into three hubs. Every hub relates to a point in a space. A hub contains data about itself and connections to different hubs. The connecting of the hubs shape a coordinated chart, as appeared in the figure. In this case, Node 2 is associated with Node 1 and Node 3, which has a connection to an outer occasion. The outer occasion permits custom activities to be appended to a hub.

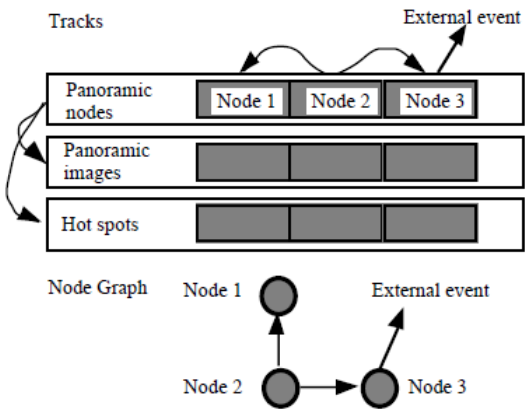

Figure 3. A panoramic movie layout and its corresponding node graph.

4.1.2 The Object Movie

A protest film ordinarily contains a two-dimensional cluster of casings. Every edge compares to a review bearing. The motion picture has more than two measurements if different edges are put away for every bearing. The extra edges permit the question have time-shifting conduct (see 4.2.2). At present, every heading is accepted to have similar number of edges.

The protest casings are put away in a consistent video track. Extra data, for example, the quantity of casings per bearing and the quantities of lines and sections, is put away with the motion picture header. The casings are sorted out to minimize the look for time while turning the question evenly. As in the all encompassing motion pictures, there is no between casing pressure for the edges since

the request of revolution is not known ahead of time. In any case, between edge pressure might be utilized for the numerous casings inside every survey heading.

4.2 The Interactive Environment

The interactive environment currently consists of two types of players: the panoramic player and the object player.

4.2.1 The Panoramic Player

The all encompassing player permits the client to perform nonstop panning in the vertical and the even bearings. Since the all encompassing image has under 180 degrees vertical field-of-view, the player does not allow turning the distance upward or down. Pivoting about the survey heading is not right now bolstered. The player performs constant zooming through image amplification and diminishment as said beforehand. In the event that different levels of determination are accessible, the player may pick the right level in light of the present memory utilization, CPU execution, circle speed and different components. Different level zooming is not right now actualized in QuickTime VR.

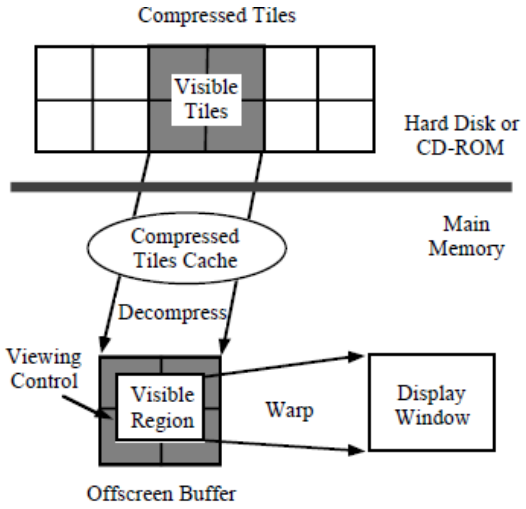

Figure 4. Panoramic display process.

4.2.2 The Object Player

While the all encompassing player is intended to check out a space from within, the question player is utilized to see a protest all things considered. The protest player depends on the traversable motion picture approach. It utilizes a two-dimensional cluster of casings to oblige question revolution. The protest edges are made with a steady shading foundation to encourage compositing onto different foundations. The protest player permits the client to snatch the question utilizing a mouse and turn it with a virtual circle like interface [27]. The protest can be turned in two headings comparing to circling the camera in the longitude and the scope bearings.

In the event that there is more than one edge put away for every bearing, the various edges are circled persistently while the protest is being pivoted. The circling empowers the question have cyclic time differing conduct (e.g. a glinting light or gushing waterfall).

4.3 The Authoring Environment

The authoring environment includes tools to make panoramic movies and object movies.

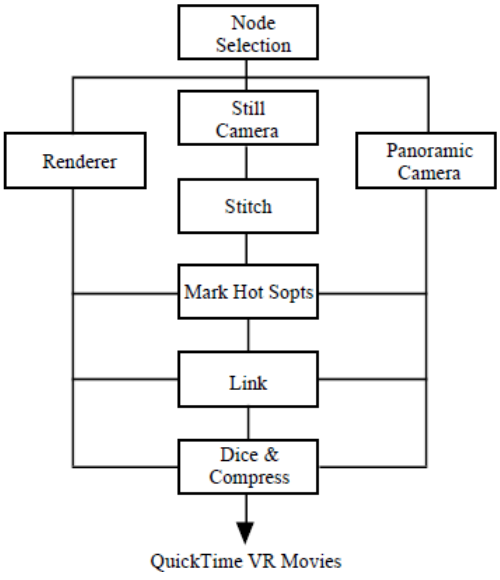

Figure 7. The panoramic movie authoring process.

4.3.1 Panoramic Movie Making

An all encompassing film is made in five stages. To begin with, hubs are chosen in a space to produce scenes. Second, the displays are made with PC rendering, all encompassing photography or "sewing" a mosaic of covering photos. Third, if there are any problem areas on the scene, a problem area image is built by stamping locales of the display with pseudo hues relating to the problem area identifiers. On the other hand, the problem areas can be created with PC rendering [28], [3]. Fourth, if more than one all encompassing hub is required, the scenes are connected together by physically enlisting their review headings. At last, the all encompassing images and the problem area images are diced and compacted to make an all encompassing motion picture. The creating procedure is outlined in figure 7.

4.3.1.1 Node Selection

The hubs ought to be chosen to keep up visual consistency when moving starting with one then onto the next. The separation between two adjoining hubs is identified with the measure of the virtual environment and the separation to the adjacent items. Observationally we have found that a 5-10 foot dispersing to be sufficient with most inside spaces. The separating can be fundamentally expanded with outside scenes.

4.3.1.2 Stitching

The reason for sewing is to make a consistent all encompassing image from an arrangement of covering pictures. The photos are brought with a camera as it turns about its vertical hub in one heading as it were. The camera container at generally equivalent, yet not correct, increases. The camera is mounted on a tripod and focused at its nodal point with negligible tilting and rolling. The camera is typically mounted sideways to acquire the most extreme vertical field-of-view. The setup of the camera is outlined in figure 8. The scene is thought to be static albeit some far off question movement might be satisfactory.

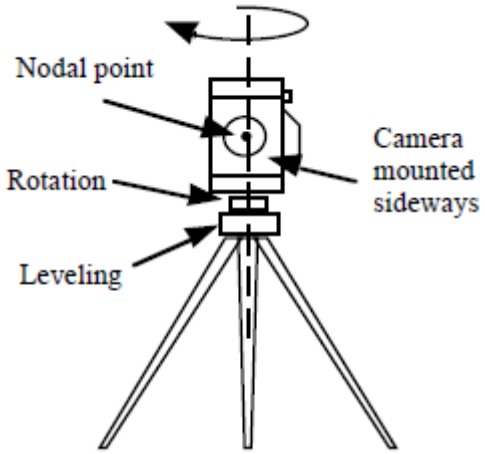

Figure 8. Camera setup for taking overlapping pictures.

The stitcher utilizes a connection based image enlistment calculation to match and mix neighboring pictures. The adjoining pictures need some cover for the stitcher to work legitimately. The measure of cover may fluctuate contingent upon the image includes in the covering locales. By and by, a half cover appears to work best in light of the fact that the contiguous pictures may have altogether different shine levels. Having an expansive cover permits the stitcher to all the more effectively smooth out the power variety.

The achievement rate of the programmed sewing relies on upon the information pictures. For a run of the mill sewing session, around 8 out of 10 displays can be sewed consequently, expecting every scene is produced using 12 pictures. The rest of the 2 displays requires some manual intercession. The components which add to programmed sewing disappointment incorporate, however are not restricted to, missing pictures, outrageous force change, inadequate image highlights, shameful camera mounting, noteworthy protest movement and film examining blunders.

4.3.1.3 Hot Spot Marking

Problem areas recognize districts of an all encompassing image for communications, for example, route or actuating activities. As of now, the problem areas are put away in 8-bit images, which restrain the quantity of remarkable problem areas to 256 for each image. One method for making a

problem area image is by painting pseudo hues over the highest point of an all encompassing image. PC renderers may create the problem area image straightforwardly.

The problem area image does not need an indistinguishable determination from the all encompassing image. The determination of the problem area image is identified with the accuracy of picking. A low determination problem area image might be utilized if high exactness of picking is not required.

4.3.1.4 Linking

The connecting procedure interfaces and registers see introduction between nearby all encompassing hubs. The connections are directional and every hub may have any number of connections. Every connection might be appended to a problem area so that the client may actuate the connection by tapping on the problem area.

Right now, the connecting is performed by physically enlisting the source and goal see introductions utilizing a graphical linker. The fundamental objective of the enrollment is to keep up visual consistency when moving starting with one hub then onto the next.

4.3.1.5 Dicing and Compression

The all encompassing and problem area images are diced before being compacted and put away in a film. The tile size ought to be advanced for both information stacking and offscreen cushion estimate. Countless expands the overhead connected with stacking and decompressing the tiles. A little number of tiles requires a substantial offscreen cushion and lessens title paging proficiency. We have found that dicing an all encompassing image of 2500x768 pixels into 24 vertical stripes gives an ideal harmony between information stacking and tile paging. Dicing the display into vertical stripes likewise minimizes the look for time included when stacking the tiles from a CD-ROM amid panning.

A display of the above determination can be compacted to around 500 KB with an unassuming 10 to 1 pressure proportion utilizing the Cinepak compressor, which depends on vector quantization and gives a decent quality versus speed adjust. Different compressors might be utilized also for various quality and speed tradeoffs. The little plate impression for every display implies that a CD-

ROM with more than 600 MB limit can hold more than 1,000 scenes. The limit will just increment as higher thickness CD-ROMs and better pressure techniques get to be accessible.

The problem area image is compacted with a lossless 8-bit compressor. The lossless pressure is important to guarantee the accuracy of the problem area id numbers. Since the problem areas for the most part possess huge coterminous districts, the compacted size is regularly just a couple kilo-bytes per image.

4.3.2 Object Movie Making

Making a protest motion picture requires shooting the question from various review headings. To give a smooth protest turn, the camera needs to point at the question's inside while circling around it at steady additions. While this prerequisite can be effortlessly met in PC created objects, shooting a physical protest along these lines is extremely testing unless an exceptional gadget is assembled.

At present, we utilize a gadget, called the "question creator," to fulfill this assignment. The question creator utilizes a PC to control two stepper engines. The PC controlled engines circle a camcorder in two bearings by altering its view heading at the focal point of the question. The camcorder is associated with an edge digitizer inside the PC, which synchronizes outline snatching with camera pivot. The question is bolstered by an almost imperceptible base and encompassed by a dark drapery to give a uniform foundation. The camera can turn near 180 degrees vertically and 360 degrees on a level plane. The camera ordinarily moves at 10-degree augments in every heading. The whole procedure may run consequently and takes around 1 hour to catch a question totally.

APPLICATIONS

The all encompassing review innovation can be connected to applications which require the investigation of genuine or fanciful scenes. Some illustration applications incorporate virtual travel, land property review, engineering representations, virtual galleries, virtual shopping and virtual reality recreations.

A case of all encompassing film application is the business CD-ROM title: Star Trek/The Next Generation – Interactive Technical Manual. This title gives the client a chance to explore in the Starship Enterprise utilizing all encompassing motion pictures. A few thousand still photos were shot to make more than two hundred all encompassing images, which cover most regions in the starship. Furthermore, numerous protest motion pictures were made from the props in the set.

The protest motion picture can be connected to envision a logical or building reenactment. Most reproductions require extensive calculations on complex PCs. The recreation results can be processed for all the conceivable view introductions and put away as a protest motion picture which can be examined by anybody with a PC.

6. CONCLUSIONS AND FUTURE DIRECTIONS

The image-based strategy makes utilization of environment maps, specifically round and hollow all encompassing images, to create a scene. Nature maps are introduction free images, which permit the client to glance around in discretionary view headings using constant image preparing. Numerous environment maps can be connected together to characterize a scene. The client may move in the scene by hopping through the maps. The strategy might be reached out to incorporate movements with time-fluctuating environment maps. What's more, the technique makes utilization of a two-dimensional cluster of casings to see a question from various bearings.

The image-based technique additionally gives an answer for the levels of detail issue in most 3D virtual reality show frameworks. In a perfect world, a protest ought to be shown in less detail when it is more remote away and in more detail when it is near the eyewitness. In any case, naturally changing the level of detail is extremely troublesome for most polygon based items. By and by, similar question is normally demonstrated at various detail levels and the fitting one is decided for show in light of some review criteria and framework execution [30], [31]. This approach is exorbitant as different renditions of the articles should be made and put away. Since one can not foresee how a question will be shown ahead of time, it is hard to store enough levels to incorporate all conceivable survey conditions.

The image-based technique consequently gives the suitable level of detail. The images are perspectives of a scene from a scope of areas. As the perspective moves starting with one area then

onto the next inside the range, the image connected with the new area is recovered. Along these lines, the scene is constantly shown at the proper level of detail.

This technique is the basic innovation for QuickTime VR, a framework for making and connecting with virtual situations. The framework meets the vast majority of the targets that we portrayed in the presentation. The playback environment underpins most PCs and does not require exceptional equipment. It utilizes images as a typical representation and can consequently oblige both genuine and nonexistent scenes. The show speed is free of scene complexity and rendering quality. The making of the Star Trek title in a somewhat brief time period (under 2 months for producing all the all encompassing motion pictures of the Enterprise) has exhibited the framework's relative straightforwardness in making an unpredictable domain.

The technique's central constraints are the necessities that the scene be static and the development be bound to specific focuses. The main constraint might be facilitated fairly with the utilization of time-shifting environment maps. The earth maps may have movements in some nearby locales, for example, opening an entryway. The movement might be activated by an occasion or ceaselessly circling. Since the movements are generally restricted to some neighborhood areas, the movement edges can be compacted proficiently with between casing pressure.

7. ACKNOWLEDGMENTS

The creator is appreciative to the whole QuickTime VR group for their gigantic endeavors on which this paper is based. In particular, the creator might want to recognize the accompanying people: Eric Zarakov, for his administrative support and making QuickTime VR a reality; Ian Small, for his commitments to the building of the QuickTime VR item; Ken Doyle, for his QuickTime joining work; Michael Chen, for his work on UI, the protest producer and the question player; Ken Turkowski, for code streamlining and PowerPC porting help; Richard Mander, for UI outline and study; and Ted Casey, for substance and generation bolster. The help from the QuickTime group, particularly Jim Nitchal's assistance on code enhancement, is likewise valued. Dan O'Sullivan and Mitch Yawitz's initial work on traversable motion pictures added to the advancement of the protest film.

REFERENCES

- Lippman, A. Movie Maps: An Application of the Optical Videodisc to Computer Graphics. Computer Graphics(Proc. SIGGRAPH'80), 32-43.
- Ripley, D. G. DVI–a Digital Multimedia Technology Communications of the ACM. 32(7):811-822. 1989. [3] Miller, G., E. Hoffert, S. E. Chen, E. Patterson, D.
- Blackketter, S. Rubin, S. A. Applin, D. Yim, J. Hanan. The Virtual Museum: Interactive 3D Navigation of a Multimedia Database. The Journal of Visualization and Computer Animation, (3): 183-197, 1992.
- [4] Mohl, R. Cognitive Sp ace in the Interactive Movie Map: an Investigation of Spatial Learning in the Virtual Environments. MIT Doctoral Thesis, 1981.
- Apple Computer, Inc. QuickTime, Version 1. 5 for Developers CD. 1992. Blinn, J. F. and M. E. Newell. Texture and Reflection in Computer Generated Images. Communications of the ACM, 19(10):542-547. October 1976.
- Hall, R. Hybrid Techniques for Rapid Image Synthesis. in Whitted, T. and R. Cook, eds. Image Rendering Tricks, Course Notes 16 for SIGGRAPH'86. August 1986.
- Greene, N. Environment Mapping and Other Applications of World Projections. Computer Graphics and Applications, 6(11):21-29. November 1986.
- Yelick, S. Anamorphic Image Processing. B. S. Thesis. Department of Electrical Engineering and Computer Science. May, 1980.
- Hodges, M and R. Sasnett. Multimedia Computing– Case Studies from MIT Project Athena. 89-102. Addison-Wesley. 1993.
- Miller, G. and S. E. Chen. Real-Time Display of Surroundings using Environment Maps. Technical Report No. 44, 1993, Apple Computer, Inc.

- Greene, N and M. Kass. Approximating Visibility with Environment Maps. Technical Report No. 41. Apple Computer, Inc.

- Regan, M. and R. Pose. Priority Rendering with a Virtual Reality Address Recalculation Pipeline. Computer Graphics (Proc. SIGGRAPH'94), 155-162.

- Greene, N. Creating Raster Ominmax Images from Multiple Perspective Views using the Elliptical Weighted Average Filter. IEEE Computer Graphics and Applications. 6(6):21-27, June, 1986.

- Irani, M. and S. Peleg. Improving Resolution by Image Registration. Graphical Models and Image Processing. (3), May, 1991.

- Szeliski, R. Image Mosaicing for Tele-Reality Applications. DEC Cambridge Research Lab Technical Report, CRL 94/2. May, 1994.

- Mann, S. and R. W. Picard. Virtual Bellows: Constructing High Quality Stills from Video. Proceedings of ICIP-94. 363- November, 1994.