EE 368 Project Proposal

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Title: Analog Virtual Reality System for Reexperiencing a Favorite Moment

Description

I propose to implement an "analog" virtual reality system to help a person re-experience the beauty and emotion of a favorite place or moment. The system consists of three parts. First the user uses an HD camera to photograph a scene from every angle and azimuth from a single point. The photos are stitched together into a mosaic on a spherical coordinate system so that the final image appears as it would if taken by a spherical camera.

Next the user maps out a room, such as their bedroom, where they would like to recreate the scene. The mapping is performed automatically by using an application to detect and map primary planar surfaces and orientations, and allow the user to select which surfaces the image should be projected on to.

Finally the user selects a "perspective point" in the room where the image will be perceived correctly. The spherical image is then centered at that point and projected back into the room where the rays connecting image pixels and the perspective point intersect the walls. Pixel values are assigned to the point of intersection of each ray and the surface image is then broken up into printable-sized sections and a print job is generated. The user then attaches the printouts to the calculated locations in the physical room. The final "experience" is observed by the user when he or she stands with his or her head located near the selected perspective point.

Technical Approach

Szeliski [1] provides a general framework for generating either cylindrical or spherical panoramas. First he shows that the focal length of the camera can be determined from a homography between two images of the same scene. With the focal length known each image can be warped into spherical pixel coordinates, with the coordinates giving pitch and yaw. Lowe [2] shows how this whole process can be automated from a collection of images to generate mosaics without any user input.

For this project the initial plan is to implement a spherical panorama generation system following the procedures given by Lowe and Szeliski and using SIFT [3] features for mapping between images. Initially this will be done on Matlab but will be transferred to a C-based application using OpenCV for some of the image processing functions and OpenGL for rendering the spherical image as a texture.

Stretch goals: Repeat this process with a spherical image of the room the user wants to map the image into. Again starting in Matlab and transitioning into OpenCV/OpenGL, the pipeline will use an edge-preserving morphological operation to clean and detect edges. The algorithm will have to find the primary corners of the room, perhaps by looking for the largest sets of parallel lines, and assuming 90-degree corners. Once processed the application will have generated a simplified model of the room with only the primary surfaces rendered. Finally the user can enter a perspective point and the OpenGL pipeline can render the image on the selected surfaces and generate a print job.

References

[1] Szeliski, R. and Shum, H.-Y. *Creating full view panoramic image mosaics and environment maps.* Computer Graphics, 31(Annual Conference Series):251258, 1997.

[2] Lowe, D.G. and Brown, M. *Recognizing Panoramas.* In Proceedings of the International Converence on Computer Vision. 2003.

[3] Lowe, D.G. *Distinctive Image Features from Scale-Invariant Keypoints.* International Journal of Computer Vision (IJCV). 2004.