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CpE 322
Homework 1
1/27/2012

Floor Plan Generation via Analysis of Panoramic Photography

The proliferation of digital cameras on mobile devices enables a wide range of applications that use visual data. One area of focus is the stitching of multiple photographs together into a panorama that can represent a much wider angle than possible with a single lens[1]. Typically, these applications focus on the aesthetics of photo stitching and are used for artistic purposes. However, there are many uses for extremely wide angle photography that are currently unexplored. One of these avenues is using information about the physical information of the camera to estimate the sizes of objects in the photograph. What I propose is: given a panoramic photograph of a room, and given some reference object in the photograph (e.g. the height of the room), compute the dimensions of the room by identifying boundaries with the walls, floor, and ceiling, and giving this information to the users.

A product that could extrapolate room dimensions from a set of photographs stitched together into a panorama would be useful to a relatively wide consumer market. Although such an application would most likely not be accurate enough for professional construction and remodeling, for homeowners looking to get approximate dimensions of a room for the purpose of arranging furniture or sizing appliances. Professionals may also use this application to get an idea of the size of a room for calculating estimated materials needed and costs.

Technically, this application would require feature extraction, and line recognition. The main challenges would be differentiating objects in the room from the room boundaries. This could be alleviated partially by focusing on the ceiling boundary, which will usually have fewer obstructions than the floor boundaries. Once the room boundaries have been identified, the distance between the ceiling and the floor can be used as a point of reference for the size of objects in the photograph.

Another piece of information that would be necessary is the relative positions from which the photos were taken. It is important because the perspective will change if the user moves around the room to take pictures, and this would alter the estimated size for the room boundaries. The user's location could be determined by integrating accelerometer data taken from the mobile device. Gyroscopic data could be used to determine camera orientation. These pieces of data would greatly improve the stitching functionality of the application, as it would give the program an approximate location for each image in the overall map.

This application would be developed on both the Android platform and the iOS platform, with a primary focus on the Android platform due to its lower boundaries to market entry. The goal would be to provide a standalone application that enables users to take multiple photographs of a room, then outputs an approximate floor plan based upon these images. The application would also enable this image to be sent via email. A possible extension to the product would be an online floor plan editor, that would allow users to position furniture and other objects on a floor plan that was uploaded via the mobile application. This would be a product developed independently of the mobile application. The market segment is homeowners in the age ranges 20-40, with an emphasis on less technical users who would be less likely to perform room measurements themselves. Key goals are a simplistic user interface and accurate feature recognition and floor plan generation.

[1] http://wmpoweruser.com/pano-panoramic-photo-stitching-app-now-available-in-windows-phone-marketplace/