Segmentation of doors in office environments

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Introduction

As part of this summer's REU at the Future Computing Laboratory, we have been assigned a project that incorporates three major areas. The first is the creation of a virtual environment and the application of a geometry modification technique to trick the user into believing he or she is walking a large distance while being contained in a defined space. Second is the alignment and registration of 3D stereo data. And third is the segmentation of doors in office environments. The three sub-projects are integrated by the idea of creating a 3D environment with the 3D images that have been aligned and registered. Knowing where the doors are positioned aids in accomplishing the geometry modification technique.

Background

Computer vision is the science discipline behind the construction of artificial systems that obtain information about images or videos.

Different areas in this field include: feature extraction, image processing, segmentation and grouping, and recognition.
Image segmentation, the area n which I am working, has many applications. Content-based image retrieval, for example, employs image segmentation to automatically classify images based on their content attributes such as textures, shapes, and objects. Image searching is a very common task, and the vast quantity of images online makes manual classification laborious and expensive. Traditional methods, such as Google Images, search based on text metadata associated with the image, which may result in inaccurate results, especially when the search term is ambiguous (e.g. "driving" for cars versus swinging a golf club). Other applications of image segmentation include segmentation of medical images to aid in early detection of health conditions, and analysis of surveillance videos for security and law enforcement.

Problem Statement

The identification and segmentation of doors in images of office environments. These images are part of a series of 2D images taken around a room, with the purpose of creating a 3D model of it. Some difficulties of this task lie in the poor quality of the images (obtained from a stereo camera), lighting conditions, and the fact that other objects in the environment may have similar characteristics.

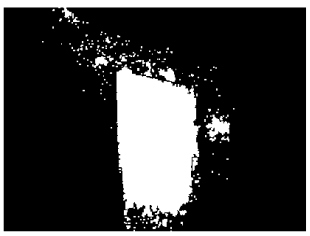
Example showing the quality of the images. Also displaying that the door and the bookcase have similar or equal RGB values.

Methods

Three sequential approaches were contemplated in order to eliminate objects with similar attributes. First, to process the image based on color obtained by a door sample, eliminating pixels outside of the sample's threshold. Second, to find lines and shapes of interest in the remaining areas, discarding anything that does not behave like a door (i.e. rectangular shape). Third, by applying a filter to the new remaining area, thus disregarding anything with a texture different than the one presented by a door.

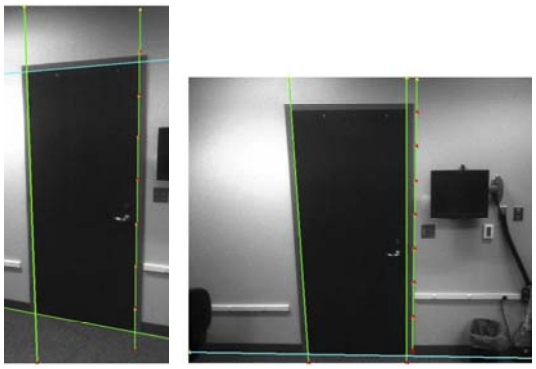
Step 1: Color

2D image data obtained from stereo camera



Pixels close to sample's threshold values

Step 2: Shapes and Lines



Application of Hough transform, tracing the lines obtained.

Step 3: Texture

Example of different textures: one of a desk and one of a door. With this difference we hope to be able to fully segment a door.

Future Work

Regarding my area:

- Application of texture filter
- Integration of all three approaches to find door segments in data

Regarding the project as a whole:

- Extend door segmentation into 3D data