A Photogrammetry System

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Abstract

The goal of this project is to design and implement a photogrammetry system. This system takes two pictures of a 3-D object at different distances and calculates the distance to certain points that can be identified as belonging to the same object. A lightsource will be used to reduce noise. The computer screen in the lab will be used to display the images and overlay distance information for points whose position could be identified in both images.

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Project Inputs: two NTSC video streams, keyboard

Project Outputs: VGA information displayed on monitor in lab, signals to robot

Approach: Image location will first be performed for a white object on a dark background with the two cameras having parallel optical axes which are perpendicular to a line drawn between the two cameras. For this case, no calibration is necessary if the effective focal length and distance between the cameras are known. Determining which pixels correspond to the same object in both images is the hard part of photogrammetry, and is trivial in this first case.

The position of the white object will be determined by sampling the luminace values from the NTSC input and keeping track of the pixels for which the values are above a threshold value. These positions will then be averaged to give a point for the object, which will be used to calculate the white spot's three dimensional position. The three dimensional position will be shown on the display on top of the white spot for the left camera system. The right camera system will also be displayed. The display is large enough that sampling the images is not necessary to display them.

Implementation: a module will be created in verilog that takes as input the luminance data from the NTSC module and outputs a stream of pixels along with an include flag which is high if the luminance exceeds a threshold value. This module also signals when a frame is complete.

An averager module will take the white pixel information and average it, providing one position coordinate. Preliminary approach is take a value, compare it to values being used, if it exceeds the lowest value, put it on the list of values. When a frame is completed, the averager calculates the average x and y positions for the two images by bit-shifting them (avoiding real division for now)

The 3-d caclulator module takes as input the average position values for the two frames and calculates the difference in the x and y pixel positions. This difference is then used with the focal length information and camera separation information to calculated the location of the object.

an image composer module takes the two camera streams as input and displays themside by side, along with the external coordinates of the image superimposed on the average pixel in each camera view.

testing: The modules will be tested independently, by simulation. The next step will be to have the image composer module display the pixels which exceed the threshold value. Once this is working, the image composer module will be used to display the pixels exceeding the threshold value and the averaged location pixel (in color). The 3-d calculator is simply a calculator, and can be tested by giving it known inputs and having it output the results to the led display. finally, the system can be put together and chceced for functionality.

The basic system is not robust and makes unrealistic assumptions about the positioning of the cameras. To get around these issues, calibration will be done